JUN 25 1925

THE ILLUMINATING ENGINEER

LIGHT LAMPS FITTINGS AND ILLUMINATION

THE JOURNAL OF

GOOD LIGHTING

OIL . GAS ELECTRICITY ACETYLENE PETROL-AIR GAS ETC.

Official Organ of the Illuminating Engineering Society

FOUNDED IN LONDON 1908

Edited by LEON GASTER

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Special Features:

Shop and Show-Window Lighting—Lighting Requirements of Railway Termini—Visits to Army and Navy Stores, Selfridge's and Waterloo Station—Lighting in Mines—Photometry—Street Lighting with Gas—Lighting of Tennis Courts, Kinema Theatres, etc.—News from Abroad, etc.

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THE GAS LIGHT & COKE COMPANY

Horseferry Road Westminster, S.W. 1

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The New Lighting of Wembley

AT the Conference on Illuminating Engineering held at Wembley last year, the view was frankly expressed that the opportunity of making the electric lighting of the grounds worthy of the occasion had been missed. When it was decided that the Exhibition should be reopened to the public this year we communicated with the authorities that an effort should be made to treat the lighting of at least a part of the grounds as an *exhibit in itself*—showing what could be done by generous expenditure of energy to produce highly original and beautiful effects, in themselves worth inspection by visitors from afar, and adding to the "drawing power" of the Exhibition.

It would of course have been preferable to have applied this idea to the whole of the electrically lighted section, but as the expenditure was apparently considered excessive, we are glad to note that the proposed plan, based on the proposals of the Electric Lamp Manufacturers' Association, aims at making a good job of the most important thoroughfare (Kingsway) with the Stadium in the background. The above illustration, furnished by the Lighting Service Bureau of the E.L.M.A., shows the effect aimed at. A feature is the use of yellow-sprayed 100-watt gasfilled lamps on high standards producing the effect of mellow sunshine; there will also be side-projectors producing pleasing contrasts in blue and pink light. Illuminated jets of steam on the tops of buildings will simulate dancing flames. The mass of searchlight beams behind the Stadium will glow with varied colours.

Whilst we understand the circumstances that rendered it difficult for the authorities to reach an earlier decision, it is evident that the delay must have made it exceedingly difficult to work out a complete and original scheme in time. Meantime we feel sure that the best possible will be done with the moderate increase in expenditure which, we understand, has been sanctioned by the authorities. We hope that when a special electrical exhibition is next held, the experience gained at Wembley will prove useful and that something really spectacular and original in the way of lighting will then be seen.

The Lighting of Shops and Show Windows

(VISIT TO THE ARMY & NAVY STORES AND SELFRIDGE'S.)

ON pages 63-65 we give an account of the first informal visit arranged by the Illuminating Engineering Society, the visit to the Army and Navy Stores and Selfridge's, on February 18th.

The two installations, both excellent types of modern store lighting, present interesting contrasts. At the Army and Navy Stores an ingenious form of flood-lighting from luminous panels in the pavement is applied to the lower part of the building. At Selfridge's, however, it is the upper part of the building which is so treated. Further, whilst at the Army and Navy Stores a system of translucent bowls and reflectors is used throughout, at Selfridge's enclosed fittings are mainly provided.

Many interesting points arose in the discussion held at Selfridge's, and kindly presided over by Mr. H. J. Clarke. A message from Mr. Gordon Selfridge was read, expressing his wholehearted belief in the commercial value of good lighting.

Mr. H. J. Clarke, aided by his able lieutenants, Mr. A. E. Bangs (Chief Engineer) and Mr. H. Seal (Display Manager), showed complete familiarity with the diverse problems discussed. It was generally agreed that the visit was a most successful one, illustrating in a very happy way the advantages of interchange of views between users and providers of light.

Our grateful thanks are due to the Army and Navy Stores and Selfridge's for granting facilities for the inspection of their premises, and especially to Mr. H. J. Clarke for presiding so efficiently over an excellent discussion, and replying in a most instructive manner to the various points raised. He showed very clearly how the lighting problems at Selfridge's had been solved by the happy co-operation of manager, chief engineer, and display manager—truly the school of experience.

Advances in Electric Mining Lamps

IT is now five years since Dr. T. Lister Llewellyn read his paper before the Illuminating Engineering Society, stating his belief that nystagmus is essentially a disease arising from work at unduly low illumination. This view was generally accepted in the subsequent discussion, in which many eminent ophthalmologists took part. It is again confirmed in the paper read by Dr. Stassen, of Liège, at the first International Conference on Industrial Hygiene last year, which is referred to on page 72 in this issue.

Undoubtedly the introduction of lamps giving increased candle-power has, in some mines, led to favourable results. Nevertheless, one does still sometimes read of cases in which the management has been disappointed—the introduction of electric lamps not having corresponded with a diminution in nystagmus, as was hoped. To what are these disappointing results to be traced? In the first place it can hardly be expected that a long-standing evil can be remedied at once; probably at least several years must elapse before the results of the new conditions can be properly traced.

But another circumstance of obvious importance is the *quality* of the miniature bulbs used in miners' lamps. A desire for all forms of economy has led some collieries to purchase miniature lamps with a life comparable with that of ordinary lamps at service voltage. In the case of miniature lamps such a life must involve under-running the lamp, so that it gives much less than the 1 c.p. to 1·2 c.p. now considered the minimum. In other cases, we understand, lamps are offered which are very cheap, but are neither efficient nor long-lived. The economy per lamp per shift realized by such choices is probably but a small fraction of a penny—a trifling amount in comparison with the direct and indirect losses occasioned by cutting down the illumination below the requisite minimum. Hence we advise all colliery managers, who still use the 2-volt lamp, to ensure that the bulbs are obtained from a reputable firm, with a clear understanding that only a life compatible with the filament being operated efficiently, so as to yield not less than 1 c.p., or preferably 1·1 c.p. should be expected.

There is, however, another possibility. If miners would consent to the larger weight involved in a bigger battery, four, or even six, volts could be used, and the lighting enormously increased. Recent researches by the National Institute of Industrial Psychology showed a material improvement in output when this was done. The only point in doubt at this time was whether the miners would consent to carry the heavier weight. Interesting experience in this direction is afforded by a miners' lamp of new design running on a 4-volt which is described on page 84 in this issue. Apparently the substantial increase in candle-power, aided by the special reflector, has made work so much easier that it has reconciled miners to the increased weight, and the lamp is coming quickly into use.

We look to see another step forward in the near future—the ultimate adoption of 6-volt or even 8-volt batteries. This would have the result that standard forms of gasfilled lamps, such as have done such good service in the automobile industry, could be employed. In these circumstances a special standard specification for lamps used in the colliery industry could doubtless be framed, if desired, and would help still further towards putting colliery illumination on a sounder basis.

Lighting of Railway Stations

ANOTHER large gathering of members assembled at Waterloo Station on March 3rd, 1925, when they had the opportunity of going over the station and seeing many ingenious applications of lighting due to Mr. A. Cunnington (Lighting Engineer to the Southern Railway).

Whilst we are aware that there is a good deal of general criticism of the lighting of our main railway stations, we think that it will at least be admitted that Waterloo is one of the best illuminated termini in this country. One got the impression that everywhere light was used with discretion and that a reason could be found for every device adopted. One might perhaps single out the lighting arrangements of the underground passages, and the illuminated time-tables, the clock-lighting, the lighting of the interior of the booking offices, and the lighting of the gangways where the tickets are examined, as special instances of careful forethought.

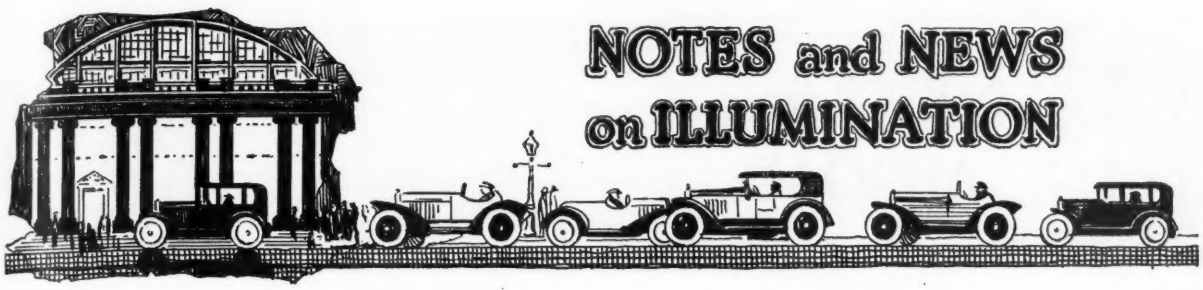
The view was expressed in the discussion, over which Mr. G. Ellson, Deputy Chief Engineer of the Southern Railway, presided, that the lighting of the magnificent approach to Waterloo Station, though no doubt well designed in principle, might be considerably increased. We ourselves share the view that the lighting of the approaches of most of our leading railway termini is hardly in keeping with their importance, and as several speakers remarked, compare unfavourably with some Continental and American stations. Mr. Ellson gave a sympathetic ear to all suggestions, but pointed out the vast expenditure involved in the lighting of a large railway terminus. A general rise in standards would mean a permanent heavy yearly expense, and engineers would be asked to show how this would be recouped by higher revenue. It is to be hoped, nevertheless, now that the great railway systems are preparing to expend money on improvements, their lighting will be improved.

Obituary

Sir ANDERSON CRITCHETT, Bart., K.C.V.O., F.R.C.S.E.
Born 1845. Died 1925.

IN the death of Sir Anderson Critchett on February 9th, a most eminent figure in the ranks of British ophthalmologists has passed away. As Surgeon-Oculist to the King, and the recipient of honours too numerous to mention, he had come to be looked up to and respected as the doyen of eye-surgeons. There has been perhaps no ophthalmic surgeon of recent years more widely known outside the ranks of his profession. With his great professional skill he united a most courteous and kindly personality, a "human touch," which at once won the confidence and affection of his patients. Like many of the great figures of his day he had wide interests. In his youth he was a good cricketer, and his musical gifts were such that at one time it seemed doubtful whether medicine or music would claim him. It was as President of the Council of British Ophthalmologists that the writer first came into close contact with him. The Council was interested in the question of the illumination of optical test-charts; with the co-operation of the Illuminating Engineering Society a series of tests were made, which subsequently formed the basis of a report. In 1920, when the Society was studying the question of eyestrain in cinemas, the Council of British Ophthalmologists rendered most valuable service. In all such matters Sir Anderson Critchett took a keen interest, and on many occasions showed his recognition of the importance of study of illumination from the standpoint of the eye. It seems but a short time since the writer had the pleasure of being present at a dinner given by Sir Anderson to a few friends. He was the perfect host, at once bringing all the company under his charm.

One of the last occasions on which the writer saw Sir Anderson, was when his views were invited on a new colour-system of lighting. It was characteristic that he would take no decision until he had examined the claims of the system in the studio, and the writer went with him. By his death the world loses an eminent ophthalmic surgeon, the Illuminating Engineering Society a friendly supporter.



Vision and Trade Efficiency

Speaking at the annual dinner of the British Optical Association on February 17th, Mr. W. B. Parker, the President, referred to the importance of good vision of industrial workers. "The large manufacturers of this country," he said, "should realize that the care of the vision of their workers is a matter of supreme importance. Opticians are frequently told by their patients that they cannot understand their vision depreciating in middle life, because their grandparents enjoyed perfect sight up to sixty or seventy years of age. . . . Such a statement shows how in the course of two or three generations the added demands of increased close work ravages the sight. . . . The production of A 1 goods demands the presence of A 1 sight in the worker, particularly in such trades as engineering and the textile industries. The keener the vision the better the work." Mr. Parker went on to recommend that every welfare department should include a refraction clinic. We agree that care of the eyes of the workers is of vital importance—but we should like to add that a matter of equal moment is the provision of adequate and suitable lighting, on which the maintenance of good vision depends.

The Value of Education

Speaking at the "Coming of Age" dinner of the Scottish Junior Gas Association on February 21st, Mr. F. W. Goodenough emphasized the value of education. "Every man is still a Junior," he said, "who has not ceased to progress; for learning, progressing and working make life worth living." Mr. Goodenough also expressed his pleasure at the formation of an Advisory Committee in Scotland to assist the Juniors. They were anxious to maintain the standard of education so that the diploma of the Institution of Gas Engineers would be worth having, and that the man who held it would be really educated in the gas industry.

A Traffic Control Tower at Victoria Station

It is reported that new arrangements are in contemplation for the direction of motor bus traffic at Victoria Station, used as a terminal for the L.G.O. services. A new feature will be a traffic control tower from which the regulating official can control, by means of signals, the movements of buses. Concrete platforms will replace the present ones of timber, and illuminated signs will be used for purposes of direction. As about 3,000 buses enter and leave the forecourt daily, the need for special methods of control will be understood, and it is interesting to observe that luminous signalling will form the main feature of the new arrangements.

Traffic Control in Leicester

In order to assist in the traffic control of one of the main roads in Leicester, the Superintendent of Public Lighting, Mr. Thomas Wilkie, acting on the instructions of the Lighting Committee, is erecting a spot-lighting apparatus. The light will be projected from a pole 30 feet high and the beam focussed on the pointsman on duty. It is hoped by this means to make the pointsman's signals clear to drivers of vehicles and also to pedestrians. The experiment is being closely watched in Leicester, as this installation will be the first of its kind in Britain.

Industrial Eyesight

In a circular issued by the National "Safety First" Association some striking figures on industrial eyesight, collected by Mr. J. R. Sawdon, of the Halifax Rotary Club, are given. From an examination of the 65,000 workers employed by the Ford Motor Co. in America, it was found that only 31,000 had normal vision. Again, in a textile factory employing over 2,000 hands, it was found that only 4·5 per cent. had perfect sight. Of the remainder 9·5 per cent. were wearing glasses that were satisfactory, 16·9 per cent. required a change of glasses, 46·8 required glasses but had none, and 22·1 per cent. did not need glasses. The textile industry is admittedly trying to eyesight. Mr. Sawdon emphasizes the need for care of the workers' eyesight. Once more we must point out another requirement—the provision of good illumination so that eyesight may be preserved.

Industrial Lighting

A lecture on the above subject, one of a series organized under the auspices of the Industrial League and Council, was delivered by Mr. L. Gaster at the Polytechnic (Regent Street) on February 17th. After explaining, by the aid of lantern slides, the main principles of good industrial lighting, Mr. Gaster emphasized the valuable educational work that can be done in this field by joint industrial councils and their research departments. Good lighting, being of interest alike to employers and workers, offers a particularly favourable field for joint action. General principles, common to all factories, can be laid down. But every industrial operation presents special problems, which can only be completely solved by those who, besides being conversant with illuminating engineering, are familiar with the processes involved.

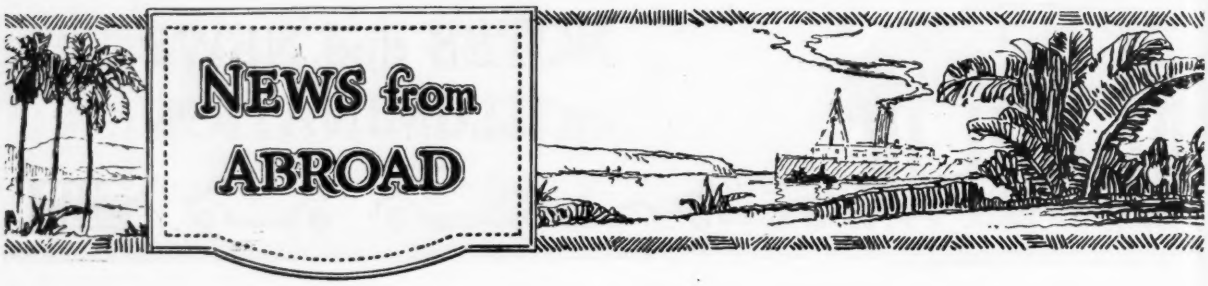
The Duddell Memorial Medal

Awarded to Prof. C. VERNON BOYS

A pleasant event on February 27th was the presentation of the Duddell Memorial Medal (awarded by the Physical Society of London for the advancement of knowledge by the invention or design of scientific instruments, to Prof. C. Vernon Boys. Mr. F. E. Smith, the President, in congratulating Professor Boys on his recovery from his recent indisposition, referred to his researches on quartz fibres and his original work on the preparation of silica tubes and vessels. The quartz fibre has proved of great value in many scientific instruments. Another of Professor Boys's achievements was the invention of the radio-micrometer, a beautiful instrument credited with the power of perceiving the radiation from a candle a mile away. The radio-micrometer was the pioneer amongst instruments of this type, which have since done such good service in researches on radiation.

The Women's Electrical Association

We observe that the Women's Electrical Asociation is proceeding with the lectures on applications of electricity, mentioned in our last issue. A course of three lectures by Miss M. Partridge has now been arranged. The first of these, on March 18th, deals with the wiring of a house; the second, on March 25th, deals with the All-Electric Home: and the third, on April 1st, is entitled, "What is Electricity?" The lectures will take place at 3 p.m. at Morley Hall (Hanover Square). Tickets (1s. each, or 2s. 6d. for the course) may be obtained from Miss Haslett, Director of the Women's Electrical Association, 26, George Street, Hanover Square, London, W.



Illuminating Engineering in Germany

At the meeting of the German Illuminating Engineering Society on January 22nd, Dr. L. Bloch made the announcement that a new offshoot of the Society has recently formed in Essen, doubtless on similar lines to that already created in Karlsruhe. At this meeting two papers by Dr. A. Gompers and Dr. W. Bertelsmann were read reviewing progress in gas lighting. Another item was the joint meeting of the German Kinema Society and the Illuminating Engineering Society, which was addressed by Mr. K. Köfinger on January 19th. The author pointed out the great importance of proper lighting in the preparation of the modern film, and mentioned that 2-3 k.w. per square metre and more were used in studios to-day. Amongst recent advances he drew attention to the use of 3-carbon arc lamps and the applications of searchlights for spot-lighting. Another interesting novelty is the magnesium candle, consisting of layers of magnesium and an oxygen-forming chemical, rated to burn for 4½ minutes and giving a very brilliant light. This is likely to be of considerable value when pictures have to be taken in places where electric light is not readily available.

Illuminating Engineering in Japan

The Illuminating Engineering Society in Japan appears to be doing good work, and its transactions contain records of varied researches on lighting problems. They have been, however, hitherto published mainly in Japanese. In conversations with Professor Yamakawa and others associated with the Society, we have pointed out that it would be very useful if abstracts in English could be issued—at least of the more important papers. We are therefore interested to receive a copy, in English, of a contribution by Mr. Ziro Yamanouti. The paper is mathematical in treatment, and deals with the calculation of illumination derived from sources of various shapes and dimensions. It appeared originally in the transactions of the Japanese Illuminating Engineering Society, and is now reprinted by the Electro Technical Laboratory of the Ministry of Communications, which is evidently performing in Japan functions similar to those of the Bureau of Standards in Washington.

The Prague International Management Congress

In our last issue we referred to the opportunities for illuminating engineering in Czecho-Slovakia in view of the keen interest taken in that country in educational problems and the application of scientific methods to industry. The conditions in this respect are strikingly illustrated in a series of papers, which we have received from the Czecho-Slovak Legation, presented at the Prague International Management Congress held in July last year. This is an impressive series of papers, most emanating from authorities in Czecho-Slovakia, but others from Russia, Poland, and the United States. Many varied industrial problems (the rôle of machinery in agriculture, vocational education, education in engineering, railway management, organization of the coal industry, sales management, public administration, etc.) are dealt with. The proceedings at this congress illustrate very well the tendency towards international treatment of problems of common interest, and we hope that at future congresses this country will be well represented.

A "House without Windows"

A correspondent sends us an illustration of the "house without windows," which has been constructed by the Osram Gesellschaft on the Warschauer Platz in Berlin. The building is devoted to the study of lighting problems and contains a well-equipped demonstration hall. Evidently discussions and demonstrations are forming an important part of propaganda in Germany, as in this country. The most striking feature of the building, however, is that it apparently possesses no windows, and is thus a continual illustration of the possibilities of artificial light. In the demonstration hall the windows are replaced by panels of diffusing glass behind which lamps are mounted, and additional light is received from a variety of units mounted overhead.

Some Developments in Electric Lighting in the United States

An article by Mr. John Liston in the *General Electric Review (U.S.A.)* reviewing progress in the electrical industry during 1924, contains some useful notes on electric lighting. About 278 million incandescent lamps (excluding miniature types) were sold in the United States. The corresponding number of miniature lamps was 210 million—an enormous figure explained largely by the demands of the automobile industry. A novel form of dustproof industrial lighting unit, with the glass globe cast all in one piece, is shown. The author illustrates a 10 k.w. lamp with two-prong new type base, developed for the use by the U.S. Night Mail Air Service. It is of interest to note the general tendency towards the replacement of open flames in mines by electric lamps fed by storage batteries. The same tendency is illustrated by the instalment of river beacons supplied by long-life primary batteries. Yet another development is the extending use of flood-lighting on railways, the battery of projectors being mounted at the top of a very high lattice-tower.

The Winner of the National Home-Lighting Contest

An example of the energetic campaign in favour of better lighting being conducted in the United States is the "National Home-Lighting Contest," arranged last year, for which the prize was a 15,000-dollars house. It is announced by the *Electrical World* that the winner of the contest was Miss Julia S. Groo, a Portland High School girl. Miss Groo also won the grand prize of 200 dollars cash in the Portland local contest. The *Electrical World* calculates that her essay was worth 25 dollars a word to her. Some prize!

The Perception of Invisible Rays by Plants

We notice that Sir Jagadis Chandra Bose, the Indian professor whose researches on the response to stimulus of metals and plant life are well known, has been experimenting with invisible light. These invisible rays (presumably those of the infra-red variety) are readily absorbed by water but transmitted by opaque materials such as coal tar and pitch. Their presence, after passage through solid substances, can be detected by a special instrument described as a "super-retina." The most interesting feature of these experiments is that these rays are apparently detected by plants, whereas the human eye is unconscious of them.

TECHNICAL SECTION

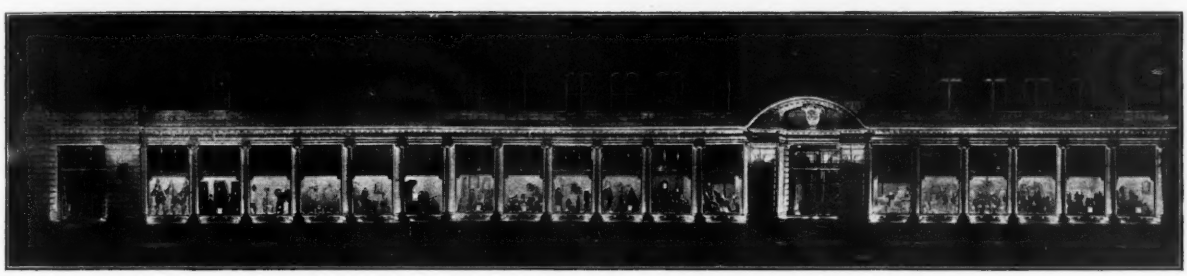
COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

The Lighting of Shops and Show Windows

Visit to the Army and Navy Stores and Selfridge's on February 18th.



A view of the frontage of the Army and Navy Stores, showing special flood-lighting.

ON Wednesday, February 18th, the first of the informal meetings and visits, now being arranged by the Illuminating Engineering Society, took place. It was felt that the time was ripe for supplementing discussions by inspections of actual installations, leading to discussion of practical results.

THE ARMY AND NAVY STORES.

The departure proved very popular, and over a hundred members of the Society and kindred bodies assembled outside the Army and Navy Stores at 5-15 p.m., where they were met by Mr. C. C. Pomeroy, the Chief Engineer. A tour was made of the various departments, and visitors were interested in the high general lighting provided mainly by 300 and 100 watt lamps in special fittings. In general, a type of fitting comprising a diffusing bowl and an over-reflector, also of diffusing glass, was used, and a feature throughout the interior was the absence of glare. It was mentioned that a special staff is kept employed in regular cleaning of lamps and fittings. The installation also illustrates the modern tendency towards using a limited number of high candle-power lamps of high efficiency, mounted well overhead, in preference to a multiplicity of small units. There were, however, many instances of special local lighting to be seen, such as the concealed lighting of glass cases containing jewellery or special goods. In case of a breakdown of the main system of lighting a special auxiliary service is provided.

Visitors, after passing through the various departments, had an opportunity of inspecting the window-lighting, and also the ingenius special " flood-lighting " provided. It may be recalled that in this case the flood-lighting is effected by special projectors, mounted under panels of diffusing glass let into the pavement. The accompanying illustrations show the pleasing effect produced by this arrangement.

Visitors were able to assure themselves, by alternately blocking the luminous panels, that quite a lot of light was actually directed upwards!

It was remarked that the method of lighting in the various shop windows differed, according to the nature of the goods. It was also understood that the amount of light allotted to departments inside varied according to the nature of display—being, for instance, specially high in rooms devoted to " sales."

(For the excellent illustration accompanying this note we are indebted to the courtesy of the General Electric Co., Ltd.)

Another view, showing luminous panels in pavement.

SELFRIDGE'S.

After a cordial vote of thanks to Mr. Pomeroy had been expressed, the party proceeded by means of two special motor buses to Selfridge's, where they were welcomed by Mr. J. H. J. Clarke, the Manager of the Staff; Mr. A. E. Bangs, the Chief Engineer; and Mr. H. Seal (Manager of the Display Department). A short tour was made of the display windows, which were considered excellently lighted, and the flood-lighting arrangements were examined in detail. The arrangements in this respect present an interesting contrast to those at the installation first visited, as the flood-lighting is applied to the upper part of the building, whereas it is only the lower region of the frontage of the Army and Navy Stores that is treated in this way.

In a subsequent tour through typical departments, it was agreed that the illumination was very well conceived, a feature again being the absence of glare. In this case the general lighting is provided by gasfilled lamps in enclosed globes, again supplemented by local lighting of many glass cases by concealed lamps.

Visitors were impressed by the very high standard of diffused illumination maintained throughout all the Departments, and it was subsequently explained that these conditions sufficed for all contingencies, i.e., all classes of goods, special sales, etc.

After light refreshments had been provided there was an interesting discussion over which Mr. H. J. Clarke presided.

DISCUSSION.

Mr. H. J. CLARKE expressed a cordial welcome to the visitors, and conveyed a message from Mr. Gordon Selfridge regretting his inability to be there in person, but saying that he realized what a vital part illumination plays in all commerce.

Mr. H. J. CLARKE said that at Selfridge's they were not theorists, but believed in testing by actual trial of various fittings, and thus obtaining really practical results. They were never satisfied with any progress they made, and were always trying to improve. Economies in current to be obtained by careful switching were not a first consideration. Rather they considered that the illumination must be provided on a generous scale. Having made sure of this, they, of course, believed in using it wisely. In testing fittings they made a point of consulting those who had to work under the illumination provided, especially those whom they felt would give a valuable expression of opinion, and not merely a statement likely to gain favour. Mr. Clarke concluded by inviting questions from the visitors.

Mr. L. GASTER expressed the thanks of the visitors for the reception they had had. He mentioned that this was the first of a series of visits which the Society hoped to arrange. Messrs. Selfridge's formed a particularly good example of enterprise in lighting, and they were pioneers in the use of concealed lighting for show window lighting. He hoped that the discussion would be free and open, and that questions would come from users and providers of illumination alike.

Mr. P. J. WALDRAM inquired as to the degree of illumination in the shop windows of Messrs. Selfridge's. He also questioned the advisability of having the same degree of illumination in all departments, whether the goods displayed were light or dark. He reminded us that what people think they see is the illumination that matters.

Mr. H. J. CLARKE, in reply, said they had not found it advisable to vary the illumination. On a large floor area the mass effect was what was of importance.

Mr. A. E. BANGS (Chief Engineer) said that the shop window lighting was provided by a low of 32 100-watt lamps (gasfilled) six inches apart, in troughs. This was supplemented by footlights and certain spotlights for occasional use, according to the goods displayed. One speaker suggested that Messrs. Selfridge's might have gone one better by flood-lighting the flags on the roof, but Mr. Clarke said that this had been considered, but had been abandoned for two reasons—that flags are usually struck at sunset, and that if they are flying at night there is danger of their not being got in quickly if a gale arises.

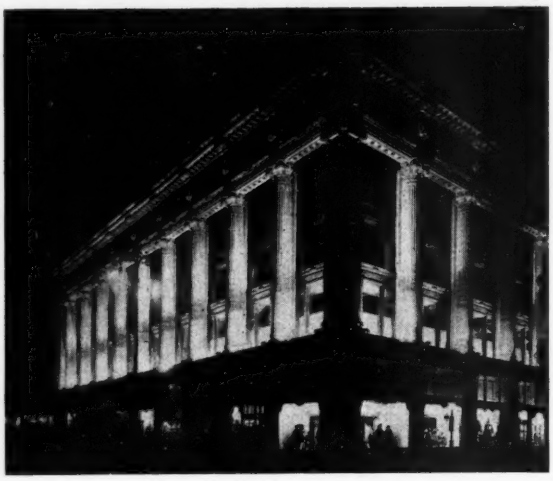


FIG. 1.—View showing the familiar flood-lighting at Selfridge's.

Mr. L. E. BUCKELL thought that Messrs. Selfridge's installation was a fine example of that generosity in illumination which he so strongly advocated. He rather wondered at the absence of contrasted coloured lighting, but no doubt there was some good reason for this.

Mr. SEAL (Display Manager), in reply, said that they had tried colour effects in show window lighting as far back as 1919, but it was always necessary for them to be changing their devices so as to maintain the interest of the public. Daylight lamps had been tried with good effect in certain departments, especially in the case of jewellery.

Mr. OSBORNE asked whether for general purposes the bluish effect of the daylight lamp or the yellower tinge of ordinary lighting was preferable.

Mr. CLARKE, in reply, said that daylight lamps were not found good for general purposes, though useful in special cases where correct appearance of colours was desired. He considered the whiteness of the gasfilled lamp most satisfactory.

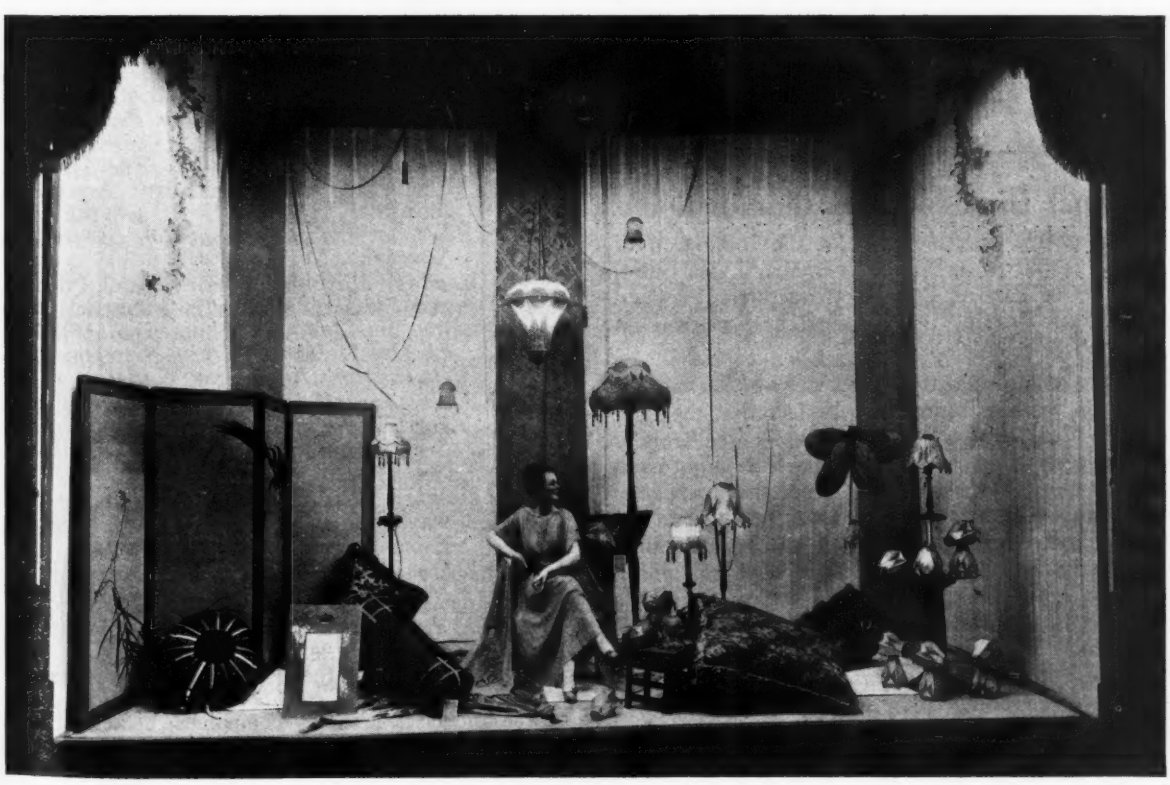
Mr. J. S. DOW said that both installations which they had visited showed generosity in lighting coupled with absence of glare. High illumination had undoubtedly its value for selling purposes. Both of the flood-lighting examples indicated a triumph over difficulties and adaptation to architectural design. Particularly was this true of the Army and Navy Stores, where the throwing of a beam of light through pavement glasses was a daring innovation. We were now arriving at a time when the architect considered his designs definitely in relation to lighting. Mr. Dow also referred to the usefulness of illuminated direction signs in guiding visitors through large stores.

Mr. H. J. CLARKE, in reply, said the best sign had yet to be designed, but they did not necessarily rely on signs for guidance. They were rather pleased to encourage questions to the staff, the homely atmosphere at a store being quite different from that of, say, a railway station.

Dr. JAMES KERR commented on the comfort of the lighting in all departments and remarked that the high illumination did not anywhere give rise to unpleasant effects.

Mr. R. A. IVES asked for particulars of wattage of lamps and floor area. He remarked that from some aspects the lamps used in the windows were visible. He also raised the question whether the use of sprayed

By the courtesy of Messrs. Selfridge we are permitted to illustrate this particular photograph, which was taken on the occasion of their 16th birthday and accounts for the decorative lighting of the "Electric Avenue," shown on the left-hand side of the photograph. The scheme was prepared by Messrs. Selfridge's own Display Department.



A delightful example of Show Window Lighting at Selfridge's.

lamps in the troughs was good practice. He suggested that coloured lights might be obtained by prismatic devices rather than by the use of absorption screens.

Mr. CLARKE, in reply, said that the average expenditure was one watt per foot and that the main fittings contained 500-watt gasfilled lamps. It was interesting to note that the floor sloped from Orchard Street towards Duke Street in order to avoid the interruption of the vista by steps, and this led to a special grading of the height of the lamps. He did not consider the visibility of the show window lamps mattered very much except at corner windows, which they were dealing with specially.

Mr. H. SEAL, in reply, pointed out that in using coloured lights it was necessary to exercise great care in order to avoid possible misconception as to the appearance of the goods, lest purchasers should think that they were being misled.

Mr. T. E. RITCHIE thought the present arrangement of the troughs in the shop windows was excellent. He doubted whether subtle tones could be obtained by a prismatic system of coloured lighting except at prohibitive cost.

Mrs. HAMMOND expressed the pleasure of the ladies at being invited to come and see such beautiful installations, and referred to the increasing interest of women in the lighting of the home as well as the shop.

Mr. BULLOCK referred to the variations that he had noticed in the degree of lighting in different departments where dark and light materials were exhibited. He thought the standard of illumination should be varied according to the class of material being exhibited. A question was also asked as to the lighting factor previously mentioned by Mr. Clarke, and that gentleman replied that one watt per foot referred to the use of gasfilled lamps. Mr. Clarke also described certain experiments that were made with colour lighting in lifts when they consulted the expert of the Beauty Department as to the most desirable lighting effects where the appearance of visitors was concerned.

Mr. L. GASTER concluded by proposing a very hearty vote of thanks to the firm for the extremely interesting way in which they had entertained the members of the Society.

(For the excellent illustrations accompanying this note we are indebted to the courtesy of Messrs. Selfridge's and the General Electric Co., Ltd.)

Informal Discussion on Illumination

At an informal meeting held at the Institution of Electrical Engineers on March 9th, Mr. C. W. Sully, Director of the Electric Lamp Manufacturers' Association of Great Britain, Ltd., opened a discussion on "Illumination."

Mr. Sully remarked that people's views of the value of illumination were influenced by the fact that they got natural lighting, free and continuously. (Incidentally it may be remarked that the idea that "daylight costs nothing" is not quite correct). Hence they were only slowly being educated to appreciate the wisdom for paying what is necessary for adequate artificial illumination. He divided his remarks into (1) what is required, (2) how to attain it, and (3) the best way to use it. In the course of the discussion several factors which influence people's judgment of lighting systems were mentioned. For instance, in the case of some forms of fine work, it is an advantage to be able to hold the object up under a local source, and observe its appearance when lighted at different angles. This cannot always be so well done by general lighting.

Lectures on Illuminating Engineering

AS foreshadowed in our January issue, a course of TWELVE LECTURES ON ILLUMINATING ENGINEERING has been arranged to take place at the POLYTECHNIC (Regent Street, London). These lectures are under the joint auspices of the Illuminating Engineering Society and the Engineering Department of the Polytechnic, and will be under the personal supervision of Mr. L. Gaster (Editor of *The Illuminating Engineer* and Hon. Secretary of the Illuminating Engineering Society).

The lectures will be fully illustrated by lantern slides and demonstrations, and will be delivered by experts on the particular aspects of illumination treated. They will be open to the outside public as well as to students of the Polytechnic. The fee for each lecture will be 1s. 6d.; or, for the entire course of 12 lectures, 10s. 6d. Copies of the syllabus and any further information desired will be available either from the Polytechnic (Regent Street, London), or from the Hon. Secretary of the Illuminating Engineering Society (Mr. L. Gaster, 32, Victoria Street, London, S.W.1).

The lectures will be delivered at 6-30 p.m. on successive Mondays and Wednesdays, commencing Monday, April 20th, 1925.

The provisional syllabus is as follows:—

(1) *Monday, April 20th.*—The Nature of Light and its Measurement, by J. W. T. WALSH *(of the National Physical Laboratory).*

(2) *Wednesday, April 22nd.*—Light in relation to Vision and Health, by Dr. JAMES KERR *(late Medical Officer to the L.C.C. Education Department).*

(3) *Monday, April 27th.*—Progress in Electric Lighting, by B. P. DUDDING *(of the G.E.C. Research Laboratory).*

(4) *Wednesday, April 29th.*—Progress in Gas Lighting and Some Other Illuminants, by J. G. CLARK *(of the Gas, Light & Coke Company).*

(5) *Monday, May 4th.*—Daylight Illumination, by P. J. WALDRAM, F.S.I.

(6) *Wednesday, May 6th.*—Colour in Illuminating Engineering, by L. C. MARTIN *(of the Imperial College of Science and Technology).*

(7) *Monday, May 11th.*—Principles of Good Lighting in the Home, School and Office, by A. KEMP *(Engineering Department of the Polytechnic).*

(8) *Wednesday, May 13th.*—(I) The Hygienic, Economic and Legislative Aspects of Industrial Lighting, by L. GASTER *(Hon. Secretary of the Illuminating Engineering Society).*

(9) *Monday, May 18th.*—(II) General Principles and Special Problems in Industrial Lighting; the Lighting of Shops, Show Windows, etc., by L. GASTER *(Hon. Secretary of the Illuminating Engineering Society).*

(10) *Wednesday, May 20th.*—Light in relation to City Traffic, by J. S. DOW *(Hon. Assistant Secretary of the Illuminating Engineering Society).*

(11) *Monday, May 25th.*—Lighting on the Railways, by A. CUNNINGTON *(Lighting Engineer to the Southern Railway).*

(12) *Wednesday, May 27th.*—The Use of Light in Modern Advertising and Publicity, by G. P. GARBETT *(of the Boro Billposting Co).*

It will be seen that the lectures cover a wide ground, and they should be of considerable service to the staffs of gas and electric supply companies, makers of lamps and lighting appliances, etc. We hope that members of the Society will use their influence to make them widely known.

The Lighting of Railway Stations

(Concours, Waiting Rooms, Offices, Approaches, Etc.)

Informal Visit to Waterloo Station, March 3rd, 1925

A LARGE number of members of the Illuminating Engineering Society and friends, including representatives of other railway systems, paid a visit to Waterloo Station on Tuesday, March 3rd.

Under the guidance of Mr. A. Cunnington (Lighting Engineer to the Southern Railway) they made a complete tour of the station. Subsequently the party sat down to light refreshments in the Dining Club Room, after which an interesting discussion was presided over by Mr. G. Ellson (Deputy Chief Engineer of the Southern Railway).

In the course of the tour visitors had first an opportunity of examining the lighting of typical platforms, where special features were the strong illumination at points where tickets were examined, and the devices for illuminating signals, clocks, etc. Descending to the underground passage that stretches across the entire platform area, attention was drawn to the method of placing lamps between projecting girders so that, looking down the passage, there was no glare. Local lighting is provided in the rooms used for weighing up luggage, a feature here being the strong illumination cast on the dials of weighing machines, on desks where papers were examined, etc.

Returning to the Concours, Mr. Cunnington pointed out various interesting devices. The additional gas-filled lamps in opal bulbs, introduced to illuminate the roof and walls and brighten the general effect, have already been the subject of comment in these columns. The racks containing time-tables, mounted on glass, and illuminated from *within*, were specially admired. (A second rack of this kind has recently been added.) The fine booking-hall at Waterloo is well illuminated, the light surroundings adding materially to the diffusion of light. Entering the booking offices, the visitors were shown the special measures taken for the efficient illumination of vertical surfaces on which tickets are stored. Finally there was a brief inspection of the lighting of the approaches and the main arch through which the station is entered. The arrangements are made on a uniform plan, and the positions of lights were judiciously selected. The only criticism voiced in the subsequent discussion was that at this important station (as at most other termini) the lighting of the approaches might with advantage be considerably increased.

The party then assembled for refreshments in the Dining Club Room, after which there was a discussion.

Discussion.

Mr. G. Ellson (Deputy Chief Engineer of Southern Railway) opened the proceedings by giving a welcome to the members of the Society. He hoped they had been interested in the lighting of Waterloo Station. The Railway Company were, he thought, justly proud of the station and of its lighting. He believed he was right in saying that their Company was one of the first to organize a department for dealing specially with lighting and covering all forms of illumination. The subject was considered of sufficient importance to justify such an organization. He then called upon Mr. Cunnington to open the discussion.

Mr. A. Cunnington (Lighting Engineer to the Southern Railway) said he would just draw attention to a few principal points before exhibiting some slides. There were certain features of particular importance at terminal stations, viz.:—

(1) *A bright and cheerful concourse*, this being the part of the station in which there is a good deal of waiting about, meeting of friends, etc. They had endeavoured at Waterloo to get the required effect by special roof lighting. It was interesting to note that this had been advocated at a discussion of the Society on a paper by Mr. Haydn Harrison, which took place many years ago, but he believed this was the first case where special attention had been devoted to relieving the gloomy appearance of the station roof.

(2) *An ample light for ticket collecting*, as necessarily a large number of tickets are dealt with at terminal stations, and it is important that no excuse should be given to the collector for passing a wrong ticket. This lighting had been obtained by special reflectors separately controlled from the general platform lighting.

(3) *The guidance of passengers* and assistance in obtaining information. This was exemplified by the special lighting of time-tables, platform indicators, illuminated platform numbers, and the extensive use of illuminated signs to show the whereabouts of the various offices.

(4) *Prevention of theft*, which required continual watchfulness on the part of the Police Authorities especially at a terminal station. It was mentioned that special lamps are provided in the neighbourhood of the lifts for assisting the police in detecting unauthorized persons when the general lighting is extinguished.

Mr. Cunnington also emphasized the paramount importance of simplification in regard to maintenance costs in railway lighting. For this reason he urged the use and design of fittings in which simplicity and ease of cleaning were prime factors. Many lanterns of extremely ingenious design and highly efficient for use elsewhere might be condemned for railway use on account of their complexity.

Mr. Cunnington then showed a few slides illustrating some of the points he had mentioned.

Mr. L. Gaster referred to the importance of approaches to stations, and remarked that many English stations still compared unfavourably with those abroad in respect of the lay-out of the approach. He pointed out that good lighting would help to minimize the existing defects. He also related instances emphasizing the importance of adequate lighting for collection of tickets.

Mr. P. J. Waldram asked if some actual measurements of illumination might be given which would indicate what prevailed at Waterloo. He referred to good lighting as a definite aid to traffic, and thought that the psychological effect of lighting was of great importance. It was not so much the actual illumination that existed, but what the public thought they saw that mattered. Incidentally he expressed the view that the lighting of the concourse at Euston Station was insufficient.

Mr. L. E. Buckell expressed appreciation of what the members had seen at Waterloo, and said it was a good example of the application of illuminating engineering principles to the diverse requirements of a terminal station. In particular, he remarked on the high illumination in a horizontal direction which had been obtained by special means in the interior of the booking office, where this special illumination was of importance for the adequate lighting of ticket racks. He called attention to the generosity frequently extended to the architectural features of a building side by side with parsimony in lighting. If at a station like Waterloo so much money could be spent on architectural effect, surely they were entitled to plead for more generous expenditure on effective lighting.

Mr. Hughes expressed his interest in the visit, and drew attention to the startling difference which prevailed

in respect of ornamental lighting when one considered terminal stations in New York. Here, at Waterloo, however, good use had been made of the material at disposal.

Mr. STEVENS (London, Midland & Scottish Railway) took the opportunity of correcting the impression regarding the concourse at Euston. He happened to have with him illumination readings which showed that Mr. Waldram's reference to the gloomy effect could not apply to the present lighting.

Mr. T. E. RITCHIE referred to the lighting of station approaches, which, he said, usually compared very unfavourably with that of the working part of the station. He took the opportunity of explaining the need for the amount of glassware in the special high candle-power lamps which had been noticed over the cabyard at Waterloo Station.

Mr. W. J. JONES referred to roof lighting and the importance of upward illumination in fittings so as to avoid gloom in the roof. He mentioned that some figures of illumination at various terminal stations had been obtained some years ago and hoped to have an opportunity of repeating the measurements so as to see what progress had been made.

Mr. J. S. DOW said that he was fairly familiar with the lighting of Waterloo Station, and appreciated the skill with which Mr. Cunnington had made use of the light at his disposal. Some reference had been made to the lighting of approaches. He thought that large railway companies did not sufficiently appreciate the publicity-value of making termini conspicuous by night; whilst there might not be the same powerful inducement to bright lighting as in stores, the provision of good illumination reflected on the prestige of a railway system and was by no means unremunerative. In conclusion, Mr. Dow thought that railways, being able to purchase current cheaply, were apt to run their lamps to a point of extreme inefficiency.

Mr. CUNNINGTON, in reply, gave some average illumination readings as follows:—

Platforms:—		
Minimum	·25 ft. candles.	Horizontal illumination measured at platform level.
Maximum	1·5 ,,	
Concourse:—		
Minimum	1·6 ,,	
Maximum	5·0 ,,	

He was bound to admit that they had in the past sometimes run lamps to very great length of life without, he was afraid, full regard to efficiency. He remembered a case in which a gasfilled lamp of early Continental manufacture had been in use for 10,000 hours and was then only taken out because of its blackened condition. He referred to the quality of the opal in the roof lamps at Waterloo, and drew the attention of members to the samples of the "Cryselco" opal type that were exhibited in the room.

Mr. ELLSON concluded the discussion with some general remarks on railway policy in lighting, reminding members that railway companies were by Act of Parliament in a very special position regarding their expenditure, and had therefore to consider very carefully how money was expended in such a matter as lighting.

Mr. L. GASTER, on behalf of those present, proposed a very cordial vote of thanks to the Southern Railways, to Mr. Ellson for presiding, and to Mr. Cunnington for his paper. He felt sure that the visitors had seen many interesting things. The vote of thanks was briefly seconded by Mr. Waldram, after which the proceedings terminated.

New Arrangements for the Lighting of the Grounds at Wembley

THE announcement is made that the Consulting Engineers, Messrs. Sparks and Partners, have invited the Electric Lamp Manufacturers' Association to put forward proposals for the electric lighting of the grounds at Wembley Exhibition, and that a scheme designed by the Lighting Service Bureau has been accepted. The lighting of the whole of the grounds could not be changed without enormous expenditure. The new effects will therefore be introduced in certain sections of the grounds in which visitors are likely to parade in the evening. Many principal buildings and entrances, and some garden beds will be outlined with electric lamps of selected colours. In the north gardens and at the south-west entrance will be installed two illuminated columns of neon tubes, some 40 ft. high, having the appearance of columns of fire.

Special attention is being given to Kingsway. Sixty tall standards are being erected. Each will be fitted with 20 yellow-sprayed 100-watt gasfilled lamps suspended from a corona fitted at the top of the post, shedding a glow of golden light on the surroundings. In order to provide contrast, and to throw into relief the collonades of the Palaces of Engineering and Industry, flood-light projectors of a special type will be concealed behind the columns. The lower projectors will be fitted with light blue screens and 1,000-watt lamps, the light being thrown upwards.

The upper projectors will serve similarly for the downward projection of light of a rose-pink colour. On the roofs steam-jets illuminated by a flood-light projector and colour-screen will resemble dancing coloured flames. The buildings will also be outlined with 20-watt yellow-sprayed lamps on 18 in. centres, the panels being treated with green lamps and the bases of flag-poles with red.

Passing over to the bridges the visitors will observe illuminated swans, ducks, Noah's Arks, water lilies and grotesque fish floating in the lake. On the rocks near Digger's Bridge a family of illuminated penguins is being installed; on the lawns and on the southern side of the lake illuminated frogs, snails, tortoises, rabbits and hares will be seen. Overhead some trees will be found to be alive with flocks of brilliantly lighted and gaily coloured parrots and owls. One spreading oak, it is announced, will be the centre of a miniature "Garden of Eden," and will bear large luminous apples. Entwined round the trunk will be a forbidding serpent studded with green lamps. The trees on the tea or dancing island will be fitted with large oranges and lemons containing 60-watt lamps. The rockery gardens and rocks will sparkle with the light of a thousand coloured tulip lamps fitted in the recesses formed by the stonework, and many of the garden beds in different parts of the ground will be outlined with gaily coloured lamps.

Standing high in the background and visible from all directions is the Stadium building. The frontage will be flooded with amber light from concealed projectors, and the colonnades thrown into relief by concealed lighting of a contrasting colour. On the roof will be a mammoth fan of coloured searchlight beams. For this purpose a battery of twelve 60 cm. searchlights, fitted with colour screens, are being installed. These units, kindly lent by the military authorities, are to be operated by the 27th A.A. Battalion, R.E. (T.A.), London Electrical Engineers.

Notes for the Photometric Laboratory

II—The Determination of Mean Spherical Candle Power by the Point to Point Method

By H. BUCKLEY, B.Sc.

(From The National Physical Laboratory.)

WHILE the use of a photometric integrator is the most convenient method of determining the mean spherical candle-power of light sources, such integrators are not always available, and recourse has to be made to the point-to-point method—which as a matter of fact forms the basis of integrating photometry. Furthermore, it is very often necessary to determine the polar distribution of light sources for the purpose of predetermining illumination values, and such measurements properly selected can also be used to determine at the same time mean spherical candle-power.

If all light sources were perfectly symmetrical about a vertical axis it would be sufficient to make measurements in a single vertical plane. This, however, is not the case. Those light sources which are not symmetrical about a vertical axis might conceivably be rotated so that measurements in a single vertical plane would then give the average distribution of candle-power in a vertical plane. This is done in the case of electric vacuum lamps, but for gasfilled lamps and gas burners such procedure is not possible, and it becomes a problem to determine which vertical planes should be selected for candle-power measurements from which the mean spherical candle-power and average polar distribution may be deduced as accurately as possible.

As a result of inquiries it appears that present practice is to take two complete vertical planes at right angles to each other, one of these coinciding with a horizontal axis of symmetry of the light source, e.g., the line passing through the centre of the ring filament and the gap in a gasfilled lamp, and through both mantles in a two-mantle burner. Measurements of candle-power are then made at every 10 degrees in each quadrant or at 10 Russell angles in each quadrant. This involves the taking of 70 or 80 observations from which the mean spherical candle-power is obtained either by means of the Rousseau diagram, the Russell angles, or some other method.

This method of taking observations may, however, lead to rather serious errors in the determination of mean spherical candle-power, since of the two complete planes chosen, one usually contains the direction in which the horizontal candle-power is a minimum (and consequently measurements in the same vertical plane, at any rate near the horizontal, are minima), and the other the direction in which the horizontal candle-power is a maximum. Now the mean of determinations in these two complete planes does not give the true mean unless the candle-power falls off lineally with respect to angle in the horizontal plane from the maximum value to the minimum value, which is not usually the case.

It is the purpose of these notes to indicate how more certainty can be brought into the methods of determining mean spherical candle-power and polar distribution, in the first place by suitably choosing the vertical planes in which measurements are to be taken, and in the second by suggesting at what angles the measurements in these vertical planes should be taken in order to give sufficiently accurate results.

Figs. 1, 2, 3 and 4 give the horizontal polar curves for the following sources—a gasfilled lamp (gap as indicated) and two, three and four mantle burners. It is obvious that the planes taken for the vertical measurements should give values of the candle-power in the corresponding horizontal directions from which can be deduced the mean horizontal candle-power of the source.

GAUSS'S METHOD OF DETERMINING MEAN VALUES.

Now Gauss has shown that the mean value of any arbitrary function which does not exhibit very rapid changes of curvature between 0° and 90° can be obtained very approximately from the formula—

$$\text{Mean value} = 0{\cdot}174\, f(6{\cdot}2^\circ) + 0{\cdot}326\, f(29{\cdot}7^\circ) + 0{\cdot}326\, f(60{\cdot}3^\circ) + 0{\cdot}174\, f(83{\cdot}7^\circ).$$

where f(6·2), etc., equal the values of the function f(o) at 6·2, etc. For our purpose, in which the function concerned is the horizontal candle-power at various angles between 0° and 90°, the above may be replaced by the following approximation:—

Mean horizontal candle-power =

$\frac{1}{6}$ c.p. at 6° + $\frac{1}{3}$ c.p. at 30° + $\frac{1}{3}$ c.p. at 60° + $\frac{1}{6}$ c.p. at 84°

If the interval over which the average is to be taken is any other interval, then the values of the angles at which the candle-power is taken must be increased or diminished proportionately.

Gauss's method thus consists in determining the angular spacing and weighting of observations such that the sum of the weighted observations at these angles gives the best approximation to the mean value over the range. If the relation between the candle-power and angle can be expressed at a function of the $(2n-1)$th degree, then n Gaussian ordinates enable the mean value to be determined exactly. Values of the angles and weights for n ordinates are given in the appendix for $n = 3$, 4 and 5.

Candle-power curves, however, are not smooth curves, but have irregularities superposed on what are usually smooth curves. Most of these curves can be expressed approximately by means of equations of less than the 8th order. The effect of the irregularities on deductions of mean values will be discussed in a later portion of this note.

The application of Gauss's rule and others to various analytical and empirical polar distributions has shown that it gives decidedly better results than rules such as Simpson's and Weddle's with the same number of ordinates.

GASFILLED LAMP.

In Fig. 1, which refers to a gasfilled lamp, measurements made at the angles mentioned above, will give the mean horizontal candle-power in any quadrant. Considerations of symmetry lead us to expect that the polar

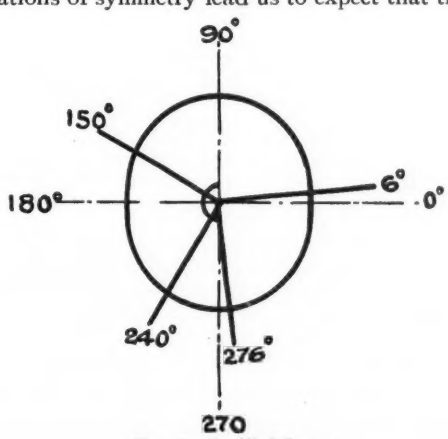


FIG. 1.—Gasfilled Lamp.

distributions will be similar in each quadrant. Thus, to obtain the mean horizontal candle-power over the four quadrants, measurements at one of the above angles should be taken in each quadrant. The positions of these angles are marked on the diagram, and the mean horizontal candle-power =

$\frac{1}{6}$ (c.p. 6° + 2 c.p. 150° + 2 c.p. 240° + c.p. at 276°).

TWO-MANTLE BURNER.

Similar considerations apply to the case of a two-mantle burner. (See Fig. 2.)

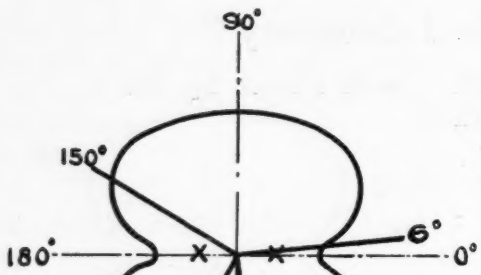


FIG. 2.—Two-Mantle Burner.

THREE-MANTLE BURNER.

With the three-mantle burner, as shown in Fig. 3, symmetry suggests that there will be six portions of the horizontal polar distribution curve similar to that between 0° and 60°. In this case, since the horizontal polar curve

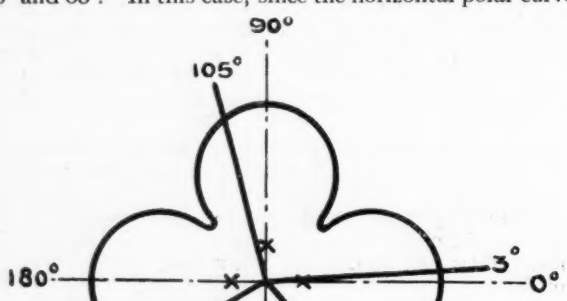


FIG. 3.—Three-Mantle Burner.

is not very far from being circular, three points are sufficient to determine the mean horizontal candle-power. Gauss's rule for three ordinates gives between 0° and 60°:—

Mean horizontal candle-power =

0·28 c.p. 6·8° + 0·44 c.p. 30·0° + 0·28 c.p. 53·2°,

or approximately,

Mean horizontal candle-power =

$\frac{1}{4}$ (2 c.p. 7° + 3 c.p. 30° = 2 c.p. 53°).

To determine the mean horizontal candle-power over the whole four quadrants a measurement should be taken in every alternate 60° arc, in which case the

Mean horizontal candle-power =

$\frac{1}{4}$ (2 c.p. 7° + 3 c.p. 150° + 2 c.p. 293°).

FOUR-MANTLE BURNER.

With a four-mantle burner considerations of symmetry suggest that the horizontal polar curve consists of eight arcs similar to that from 0° to 45° in Fig. 4. The corresponding Gaussian angles, of which four are desirable in this case, are one-half those for the range 0 to 90°, i.e., 3°, 15°, 30°, 42°, and the formula for mean horizontal candle-power taking one measurement in each alternate octant, is:—

Mean horizontal candle-power =

$\frac{1}{8}$ (c.p. 3° + 2 c.p. 105° + 2 c.p. 210° + c.p. 312°.)

MULTIPLE-CLUSTER BURNERS.

For clusters containing more than four burners the horizontal polar distributions are approximately circular,

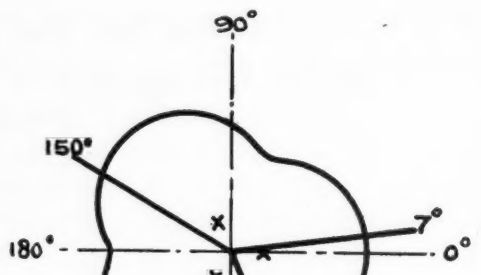


FIG. 4.—Four-Mantle Burner.

and it probably does not matter very much which angles are chosen at which to make measurements.

TEST OF THE METHOD IN AN ACTUAL CASE.

Fig. 5 gives the light distribution in an horizontal plane from a four-mantle cluster. The mean horizontal candle-power deduced from measurements made every 10° was found to be 151 candles.

Calculations using the four ordinates at angles given above gives:—

(a) 152 candles, starting point at 0°.
(b) 146 candles, starting point at 90°.
(c) 151 candles, starting point at 180°.
(d) 157 candles, starting point at 270°.

Thus to an accuracy of 4 per cent. the four ordinates give the mean horizontal candle-power of the cluster.

POLAR CURVE IN A HORIZONTAL PLANE OF THE LIGHT DISTRIBUTION FROM A FOUR MANTLE BURNER SHOWING THE ANGLES AT WHICH MEASUREMENTS IN VERTICAL PLANES SHOULD BE MADE.

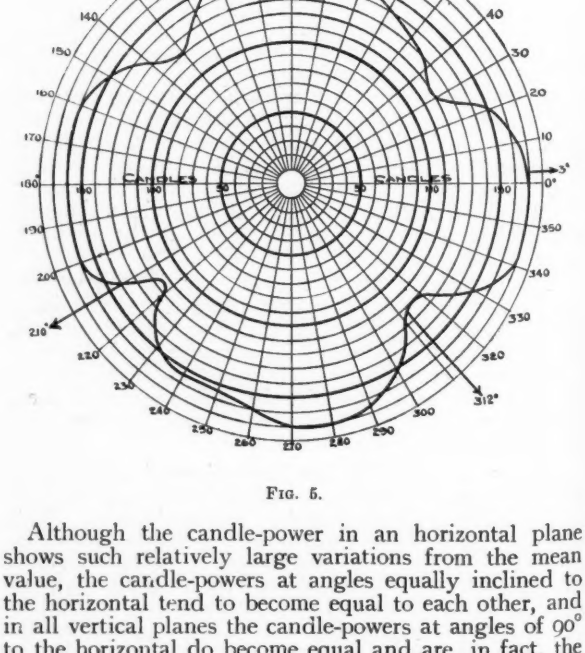


FIG. 5.

Although the candle-power in an horizontal plane shows such relatively large variations from the mean value, the candle-powers at angles equally inclined to the horizontal tend to become equal to each other, and in all vertical planes the candle-powers at angles of 90° to the horizontal do become equal and are, in fact, the candle-power in the upward or downward verticals. Thus we may expect mean spherical candle-power determinations to be less affected by error than mean horizontal candle-power determinations.

(To be continued.)

Gas Lighting in Germany

AT the meeting of the German Illuminating Engineering Society on January 22nd, a series of three papers were delivered dealing with the position of gas lighting. The first of these, by Dr. A. Gumpers, reviews the question of mantle construction. In his introductory remarks the lecturer pointed out the variety of industries concerned in mantle manufacture. The isolation of the thoria and ceria from the monazite sands was a highly complex chemical process; the preparation of the fabric was a textile operation, and the design of the burner a task for workers in metal. Dr. Gumpers recalled that Welsbach's original mantle was shown before a meeting of the Gas und Wasserfachmanner on June 9th, 1886. The improved mantle utilizing ceria was presented in Kiel in 1892. From this time onward progress was continuous.

Dr. Gumpers next explained in turn the characteristics of the cotton fibre, Ramie and artificial silk fabrics. It was pointed out that the artificial silk fabric, unlike vegetable fibre, allowed no space for the expansion of material involved in the explosive decomposition of the thorium nitrate; hence with this material it was necessary, by treatment with ammonia, to convert the thorium into the salt hydrate. A feature of these mantles was their elasticity and their development as "self-forming" mantles, i.e., automatically accommodating themselves to the shape of the flame.

The next paper, by Herr H. Mattenklott, dealt mainly with the difficulties introduced by the coal position during the war. Prior to the war gas lighting had reached a very high standard, due mainly to the careful design of burners to suit the quality of gas then available. All the greater, therefore, was the shock when, owing to the great scarcity of coal a large addition of water-gas had to be used, and a quality of gas delivered for which the existing burners were quite unsuited. It was early recognized that methods of reconstruction were necessary, and though much still remains to be done, substantial progress has been made. The author mentions various researches resulting in new types of mantles and burners, the essential feature being the use of a smaller mantle fitting the new shape of flame obtained with the changed quality of gas.

It is hoped that the new designs of burners will lead to further advances and that ultimately a "half-litre" burner, corresponding to the "half-watt" electric lamp, may be evolved. The prospect for gas lighting is now not so bad. A temporary set-back has been given by the practice of certain municipal undertakings, owning both gas and electricity, to concentrate on the use of gas for heating, dealing with lighting and power by electrical methods. But in other directions developments are proceeding. The author emphasizes one great problem on which research should be directed—the development of automatic methods of lighting up and extinguishing. He speaks with approval of various pleasing forms of portable lamps and fittings recently introduced. Finally he points out that the future of gas lighting demands an energetic effort to explain to the consumer the handling of his lamps and the necessity for proper maintenance. He should understand that just as much as he discards used-up electric lamps, so must similar attention be given to gas fittings. It would pay gas companies ultimately to undertake free maintenance.

The third contribution, by Dr. W. Bertelsman, also reviewed the problems arising from the lack of coal during the war, and the consequent change in the constitution of the gas supplied. In the confusion arising at the worst period the makers of gas appliances were helpless. Conditions were very variable and they did not know what requirements to meet. These troubles have been largely overcome by the agreement to adopt gas of a specified calorific value (4,200 W.E.) and it is now realized that equally good results can be obtained from the "poorer" gas now supplied, provided the smaller air-content required and the smaller flame were met by suitable mantle and burner design. Suitable lamps to meet these requirements have now been introduced. Unfortunately the public, not being sufficiently educated as to the reason for the change, was inclined to regard it merely as a device by the mantle makers to save material. For some time variations in calorific value of 300 to 400 W.E. were not uncommon. But to-day gas works are responding to the agreement arrived at in 1922 to adhere closely to the 4,200 W.E. value. Dr. Bertelsmann next discusses in some detail the constitution of gas as now manufactured. He comes to the conclusion that the nitrogen forming a constituent of the gas is of small moment in view of the nitrogen inevitably entering in the air supply. It has, however, been found advisable to specify that the proportion should not exceed 15 per cent. The essential thing is the maintenance of the prescribed calorific standard. If this is adhered to makers are in a position to attain the maximum possible efficiencies and gas lighting should shortly win back all the ground lost during the war.

In the discussion, Dr. Pfeiffer, of Magdeburg, laid special stress on street-lighting as affording opportunities for gas, pointing out the favourable impression created by hundreds or thousands of effective gas lamps in the public streets. Unfortunately in his city the diminutions in public lighting carried out as a measure of economy during the war had not been fully made good. The speaker also emphasized the value of methods of distant control. Dr. L. Bloch, who presided, said that notable progress in public lighting, both as regards gas and electric lighting, had been made in Berlin. It was remarked by Dr. A. R. Meyer, however, that it was not sufficient to restore the pre-war standard. Undoubtedly the growing volume of motor traffic rendered necessary public lighting even better than that provided before the war.

Intrinsic Brightness and Glare

In a paper, produced in *Die Lichttechnik*, the official organ of the Illuminating Engineering Society in Austria, Dr. Lux recently contributed an analysis of "glare." He remarked that the greatest brightness attainable with a black body would be reached with a temperature near 6,750° abs. In practice the nearest approach is attained in the carbon arc (about 4,000° abs.). Lummer, in his arc, working under 22 atmospheres, is said to have obtained an intrinsic brightness of 284,000 H.K./sq. cm. But the highest valuable met with in practice is probably that of the crater of the Goerz-Beck searchlight (120,000 H.K./sq. cm.).

Figures were subsequently given for the brightness of illuminants used in ordinary practice. But it was pointed out that the impression of glare does not depend on brightness alone. The position of the source with respect to the eye is highly important. By suitable diffusing globes the brightness can be reduced to a very moderate figure. In this connection the problem of measuring brightness arises. Dr. Lux points out that the usual methods give rise to somewhat uncertain results. The little apparatus devised by Dr. Hartinger (recently mentioned in this journal) seems likely to prove a useful implement.

Miners' Nystagmus and Vision by Weak Illumination

IN the course of a recent discussion before the Royal Society of Medicine a good deal of light was thrown on the curious complication of troubles grouped under the name of miners' nystagmus. Nystagmus is the name given to a curious, rapid, tremorous movement of the eyeballs, due to nervous causes, and frequently seen in slight degree in miners. In some, indeed, it becomes very marked, and these also frequently show other signs of nervous want of control of an emotional and hysterical nature, which we became accustomed to during the war as shell shock. In the discussion in the Ophthalmological Section on February 13th, the clinical picture of these cases showed how miners who are liable to nervous functional disorders often unconsciously built up on the nystagmus which is so common among them, a complicated set of troubles, any of which were now often assigned to this miner's nystagmus. It was very significant that the sufferers deteriorated if they were allowed to remain idle.

The explanations of Professor J. S. Haldane, of Oxford, enormously cleared the ground from the illuminating engineering point of view. He said there was now a general acceptance of the nystagmus as brought about by using the eyes for guidance in muscular movements when the luminosity of objects was very low. Within wide limits of illumination the acuity of vision was practically constant, but at very low illuminations it fell off seriously till black and white objects could not be distinguished. With even moderate illumination visual acuity was greater at the centre than in the periphery of the field of vision. On the other hand, with poor lighting it became very poor at the centre, so that the periphery now was best. One must remember that the corresponding areas in the eye have separate nerve supplies to account for this.

With sufficient luminosity the consciousness of an object seen at the centre remained and the object continued to be seen, but in the periphery objects were seen at first, and then fade so that only moving or changing objects are consciously noticed there. With very low degrees of illumination the vision at the centre becomes even less than at the periphery, and the eye, trying subconsciously to see the object as clearly as possible, wanders, picking up the object at the centre and then losing it again. It may be remarked that this is the ordinary process of vision in good light, but the eye does not lose the object it is centred on, and that its movements once it is centred are small. In the poor light these searching movements are continuous and relatively large, as the periphery has to be used. This continuous effort means a chronic fatigue. Nystagmus is therefore a kind of bad habit learned in poor illumination, and causing a chronic muscular eye fatigue. When oil cap lamps are used they illuminate the actual work and there is no nystagmus. The illumination necessary must be sufficient for maintained vision by the foveal area at the centre of the eye, so that the eye can be fixed on the object, and guide the miner's tools. Professor Haldane, who is our greatest authority on respiratory and ventilation questions, could see no reason for supposing that any abnormal gases in connection with coal getting affected the trouble.

Mr. Elworthy, of Ebbw Vale, thought that the quality and not necessarily the candle-power, was most important. There was an excess of blue rays which at Ebbw Vale they had tried to cut down with yellow-tinted glass, and the miners had suffered less. The minimum amount of light necessary in the pit to bring out steam coal with safety was 0·9 c.p. It was pointed out by Mr. C. J. Sachs that the ordinary glass cut out the ultra-violet rays.

Professor Collis, of Cardiff, looked on the increase of nystagmus as apparent rather than real. He regards it as a physical symptom, the nystagmus, on the exhaustion of which is often grafted the other neurasthenic functional symptoms. The period of compensation is not limited, and this fact alone will aggravate such a disease. The compensation processes have undoubtedly been accompanied by increases in the numbers of chronic cases notified.

Mr. H. Mitton, the engineer of the Butterley Collieries, with some 7,000 men, had had a decrease of certified cases from 0·95 per cent. in 1913 to 0·56 per cent. in 1924, which he put down to improvement in illumination.

J. K.

Visual Fatigue amongst Workers in Mines

By Dr. STASSEN (Liège)

IN a paper presented at the First International Conference for the Study of Industrial Hygiene, held in Geneva last year, Dr. Stassen, of Liège, gave an account of his researches on miners' nystagmus. This affection of the eyes he believed to be primarily due to visual fatigue, and, in his opinion, the necessary and sufficient cause was the injurious effect of long-sustained work under unsatisfactory lighting conditions.

After detailing the chief symptoms of the disease, Dr. Stassen mentioned that of 20,000 workers in coal mines examined, about 5,000 (25 per cent.) showed appreciable signs of visual fatigue. Of these 5,000, 4,200 were little inconvenienced; but the remaining 800 suffered from serious trouble, and two were completely incapacitated from work. Dr. Stassen next quoted data to illustrate the direct relation between the disease and the lighting conditions. Thus 35 out of 10,000 workers using safety oil lamps suffered from some degree of nystagmus, but only 12 out of 10,000 using special spirit lamps, and only 8 per 10,000 amongst those using portable electric lamps; whilst no cases were recorded in mines where it was possible to use open flames. Similar results are derived from an analysis of the graver cases: 57 cases per 1,000 workers using safety oil lamps; 13 per 1,000 workers using candles and open flames; 12 per 1,000 workers using electric lamps. On the other hand, no cases were noted amongst (*a*) workers in lead and iron mines using acetylene lamps with suitable reflectors, and (*b*) workers in parts of coal mines where permanent lighting by 32 and 60 c.p. lamps was installed.

Dr. Stassen, therefore, again repeats his conviction that sustained work under inadequate light is the primary cause of this disease, and that the remedy lies in providing more effective illumination in the galleries of mines. It is, however, necessary to consider other things besides actual candle-power. The chief considerations are (1) too feeble candle-power (2) lack of constancy in the source of light (3) unsuitable colour of rays light, and (4) insufficient protection of the eyes against glare from exposed sources

The candle-power obtainable from the usual forms of lamps is approximately 0·5 to 1 (Hefner) from candles, 0·5 from safety oil lamps, 1 from special (Wolf) spirit lamps, and 1·2 to 2 c.p. from portable electric lamps. Attention is drawn to the tendency of light from flames to be affected by the atmosphere of the mine, and in general flames need to be protected so as to eliminate flickering so far as possible. An evident drawback of the electric lamp, as often used, is the glare from the exposed filament. Dr. Stassen quotes with approval the form of cap-lamp suggested by Dr. T. Lister Llewellyn in this country, and the recommendations that have been made with regard to the use of suitable screens and reflectors. Another matter that has been receiving attention is the use of a yellow-tinted cover glass over the lamp-bulb. This appears to have been originally suggested in view of the impression that, in the dark surroundings in mines, the violet and ultra-violet light in the spectrum of an unscreened filament is trying to the eyes. Whatever the explanation may be, experience in some mines suggests that the use of the yellow glass has a restful effect.

The whole question of lighting in mines is of great importance, and it is to be hoped that it will be the subject of study by the International Hygiene Section of the International Labour Bureau of the League of Nations.

POPULAR & TRADE SECTION

COMPRISING

Installation Topics—Hygiene and Safety—Data for Contractors—Hints to Consumers

Some Notes on Electric Lamps

No. 3

By W. J. JONES, B.Sc., A.M.I.E.E.

(E.L.M.A. Lighting Service Bureau).

THE SIZE OF ELECTRIC LAMPS AND THEIR EFFICIENCY AND INFLUENCE OF VOLTAGE ON EFFICIENCY.

AT the present day all efforts are directed towards obtaining the maximum amount of light at the minimum expenditure of energy, and one is quite often asked the question: "Is it better to use three small lamps or one of equivalent watts' consumption?" Part of the reply to this question is intimately connected with the variation in the efficiency of lamps with their size. It is common experience the larger the generating plant the higher its efficiency, and the electric lamp, as a generator of light, is no exception in this respect. A study of the British Engineering Standards Association Specification for Normal Type Tungsten Filament Lamps, No. 161—1924, indicates that the efficiency is not directly proportional to the wattage of the lamp, but increases at a greater rate.

TABLE 1.

RATINGS OF GASFILLED LAMPS AS PER B.E.S.A. SPECIFICATION No. 161.

Rated Volts.	Rated Watts.	Lumens per Watt Max.	Watts per Mean Spherical Candle Max.	Lumens Approx. Rated Lumens.	Lumens Max.
	30	10·6	1·58	275	327
	40	11·4	1·47	390	469
	60	12·8	1·31	660	791
100	75	13·4	1·25	875	1,050
	100	14·6	1·15	1,250	1,440
to	150	15·3	1·10	1,970	2,260
	200	15·9	1·05	2,730	3,140
130	300	16·5	1·01	4,260	4,900
	500	18·7	0·90	8,000	9,200
	1,000	20·0	0·84	17,100	19,700
	1,500	20·0	0·84	25,700	29,600

It will be noticed that the efficiency of the 1,500-watt lamp is 20 lumens per watt, while that of the 30-watt lamp is only 10·6 lumens per watt, the efficiency of the higher wattage lamp being almost double that of the lower. A few units of large wattage lighting a room is therefore more economic than a multiplicity of smaller ones. Fig. 1 indicates how rapidly the efficiency of a lamp increases with the wattage, particularly in the smaller sizes. The reason for this increase in efficiency is essentially connected with the fact that it has been found possible to operate a thicker filament at a higher temperature than a thin one for the same length of life. (See S. Dushman, *General Electric Review*, Volume 18, page 156, 1915.) An increase of temperature of the filament of a gasfilled lamp of 1 per cent. produces approximately 12 per cent. increase in the lumens output. It will, therefore, be appreciated that a slightly higher operating temperature brings about an enormous increase in the amount of light that the lamp will give.

There is yet another point which should be fully appreciated, and which is closely connected with the size of filament, namely, the difference between the efficiency of high voltage lamps (200-260 volts) and low voltage lamps (100 to 130 volts). Table II gives the efficiencies of high voltage lamps, and it will be noticed that in every case the efficiency is less than the corresponding low voltage lamps. This is due to the fact that the filament of a high voltage lamp is much longer, and approximately half the cross-sectional area of the low voltage lamp. Since the filament is thinner it cannot be run at such a high temperature, and the efficiency is therefore correspondingly less. This difference in efficiency is also clearly indicated on the graph in Fig. 1.

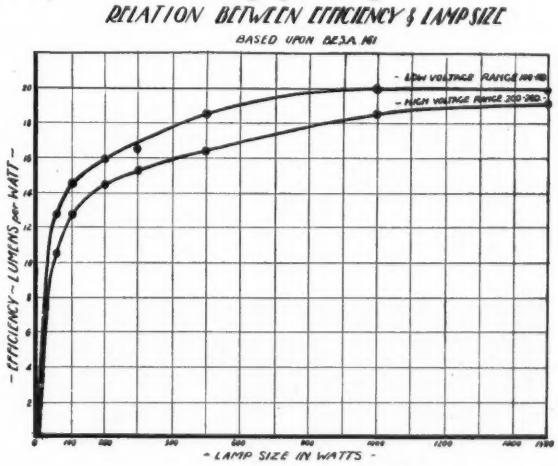

RELATION BETWEEN EFFICIENCY & LAMP SIZE
BASED UPON B.E.S.A. NO
- LOW VOLTAGE RANGE 100-130
- HIGH VOLTAGE RANGE 200-260
- EFFICIENCY - LUMENS per WATT -
- LAMP SIZE IN WATTS -

FIG. 1.

TABLE 2.

RATINGS OF GASFILLED LAMPS AS PER B.E.S.A. SPECIFICATION No. 161.

Rated Volts.	Rated Watts.	Lumens per Watt Max.	Watts per Mean Spherical Candle Max.	Lumens Approx. Rated Lumens.	Lumens Max.
	40	8·85	1·89	305	365
	60	10·6	1·58	545	654
200	75	11·4	1·46	750	905
	100	12·8	1·31	1,100	1,320
to	150	13·4	1·26	1,720	1,970
	200	14·6	1·15	2,510	2,880
260	300	15·3	1·10	3,930	4,520
	500	16·5	1·01	7,110	8,170
	1,000	18·7	0·90	16,000	18,400
	1,500	19·3	0·87	24,830	28,550

Shop-Window Lighting

We note that Mr. H. J. Roberts, of the Electrical Department of the Glasgow Corporation, recently gave a lecture before the Glasgow Branch of the Scottish Music Merchants' Association on the above subject. The paper was illustrated by demonstrations, and the great advertising value of well-lighted shop-windows was brought home.

Some Installations Using Coloured Lamps

IT has been recognized for some considerable time that good lighting possesses a great power of attraction, but until recently we, in England, were slow to introduce colour into our lighting effects. This may be attributed to the fact that hitherto electric light was expensive; but now that light sources are more efficient and powerful, essentially due to the introduction of the gas-filled lamp, coloured light is being more and more extensively used.

It has been stated by some authorities that the attracting power of coloured light, when used scientifically and with due regard to the surroundings, possesses at least twice the appeal of ordinary white light. It should be borne in mind, however, that at least twice the amount of light is required at the source in order to obtain satisfactory coloured effects than if clear lamps were used. The majority of failures have been due to the non-realization of this fact. There are four commercial methods of producing coloured light from incandescent electric lamps at the present time:—

1. *Varnish.*—This has the advantage of being easily applied and obtainable in a large variety of colours, but this method is unsatisfactory, due to the fact that the colouring is far from permanent, especially when used on gasfilled lamps.
2. *Natural Glass Bulbs.*—There are good and sufficient commercial reasons for not producing a large range of tinted glass bulbs for lamps; chief among which is the practical difficulty of stocking.
3. *Sprayed Lamps.*—This process has the advantage of being cheap, while the diffusion of the light over the whole area of the bulb reduces the somewhat harsh effect obtained by other methods.
4. *Coloured Screens.*—This method employs the use of coloured screens of gelatine, glass, etc., which can be used in front of the fitting containing the lamp. This method lends itself admirably to obtaining effects in shop windows, on theatre stages, and other similar conditions where the results are being observed, as it were from outside.

The illustrations given on this page show some uses of colour-sprayed lamps, and reference was made in a previous article to the permanence of this method of

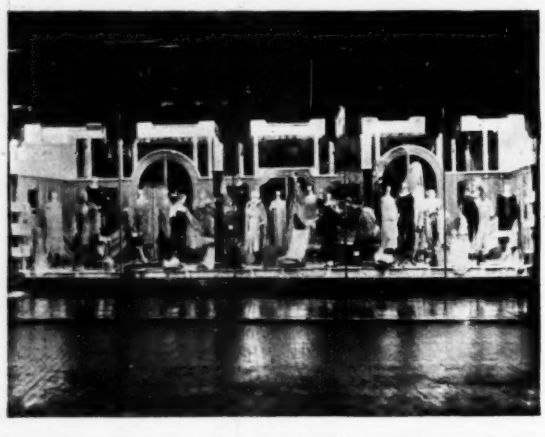


FIG. 1.—Shop windows using nearly 1,000 colour-sprayed lamps, installed in troughs near front of windows.

colouring lamps. The shop windows illustrated (Fig. 1) employed nearly 1,000 colour-sprayed lamps, which were installed in trough reflectors fitted near the front of the windows; both the lamps and reflectors were hidden from view by means of a pelmet, and the lamps themselves spaced six inches from one another. The lamps used on the occasion when the photograph was taken were coloured so as to emit an amber light, which so flooded the windows as to suggest brightness and warm sunshine. It is reported that the number of potential shoppers who were attracted by the windows have been considerably increased since the introduction of this new method of shop lighting.

It will be noticed that there are now several installations of this kind in London and the Provinces, and the use of colour in shop-window lighting is being more extensively appreciated, both by the onlooker and the shop-window dresser.

Yet another striking use for colour-sprayed lamps is their extended application to gala and festival effects at popular seaside resorts, where they are found capable of entirely withstanding the harsh weather conditions. Their ability to withstand such conditions has also resulted in their introduction to sign lighting, and there are many beautiful signs which depend essentially for their attractiveness upon the introduction of the colour-sprayed lamp. Below (Fig. 2) is a recent sign which was constructed for the London Pavilion. The border of

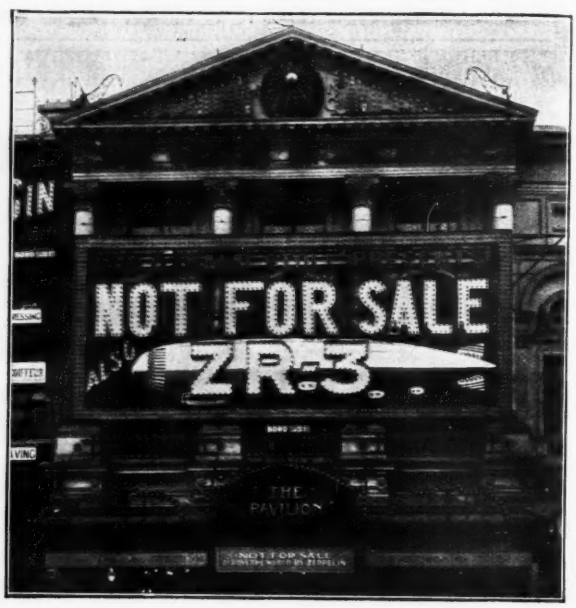


FIG. 2.—Showing a recent sign constructed for the London Pavilion, also using colour-sprayed lamps.

this sign consisted of 768 orange-coloured sprayed 30-watt spirallized filament sign lamps, while the "Not for Sale" and "Z R. 3" were illuminated by means of 633 40-watt daylight blue sign lamps. The illumination of the Zeppelin itself is rather interesting, since it was flood-lighted from a series of brackets, each carrying an elliptical angle reflector fitted with a 150-watt lamp. We believe that this is the first time that a sign employing flood-lighting in this novel manner has been installed.

Fig. 3 is the photograph of a sign employing exclusively colour-sprayed lamps. There are 768 green colour-sprayed lamps in the border, while "The Ten Commandments" is illuminated by means of red-sprayed lamps, and the remainder of the lettering with orange.

More Light

Reference was given in the last issue regarding the proposed Illumination Design Course which was to be held for Supply Authorities, and it is gratifying to hear that no less than 100 Central Station Engineers attended the four-day courses on Illumination. The ground covered included fundamentals of lighting, special display illumination, colour effects, manufacture of lamps, industrial and domestic lighting, and many other branches of the subject. Each member who attended the complete course was presented with some notes incorporating the chief matters which had been dealt with during the course, and containing much useful data.

During the whole course great enthusiasm prevailed, which, if translated into activities in the districts from which the representatives came, will do much towards bringing about better standards of illumination. All efforts in this direction are worthy of commendation.

Colour as an Appeal in Advertising

The foregoing illustrations show how large a part colour is now playing in spectacular lighting effects and "illuminated publicity."

When the brighter new illuminants, such as the gasfilled lamp, first appeared, the natural tendency was to aim at *brilliancy* in order to attract attention. But it was soon discovered that the mere lavish use of light did not effect its object—as it is always possible for a neighbour to "go one better." From the public standpoint glaring effects are to be deprecated. They raise criticism and alienate the sympathy of those who would otherwise encourage the use of light for publicity.

Hence a new stage has been reached. The up-to-date modern advertiser seeks rather to attract notice by the ingenious use of colour-contrasts; by making his designs not merely "catch the eye," but *hold* it. It has been said that "some signs serve to startle rather than to attract." In the long run an illuminated advertisement which the eye finds it a pleasure to dwell upon is the best advertisement.

FIG. 3.—"The Ten Commandments," a sign using exclusively colour-sprayed lamps.

Illuminated Tennis Courts

THE lighting of lawn tennis courts has long proved a difficult problem, and in our January issue we published an account, from Mr. C. A. Rossander, of the method adopted in some covered courts in Stockholm. The number of covered courts available is, however, much exceeded by those out of doors, and in such cases the absence of surrounding reflecting surfaces introduces quite distinct conditions. Much interest is therefore being taken in the lighting of the Edmonton U.D.C. hard courts, in accordance with a scheme designed by Messrs. Siemens and English Electric, Ltd., and carried out by the North Metropolitan Electric Power Company.

The lay-out was the subject of very careful consideration. The courts are arranged in pairs. In order that no posts should interfere with the play, all lights must be erected on the outer sides of the rectangle. Accordingly, 500-watt lamps in enamelled steel angle reflectors are mounted at a height of 24 ft. along each side. A single concentrating unit is also mounted at each end of the space between the courts.

The results have been very satisfactory. We understand that the light-distribution is very even and that there are no inconvenient shadows or bright spots. One feature of this system of lighting from the sides is the avoidance of glare in the eyes of players.

The accompanying illustration gives a good idea of the conditions The actual illumination is between 1 and 2·5 foot-candles. This intensity could easily be substantially increased if desired, but it is believed that the present arrangements meet the requirements of the average player. The courts have been recently opened to the public for evening play, and local residents have been quick to take advantage of this latest addition to "Brighter London."

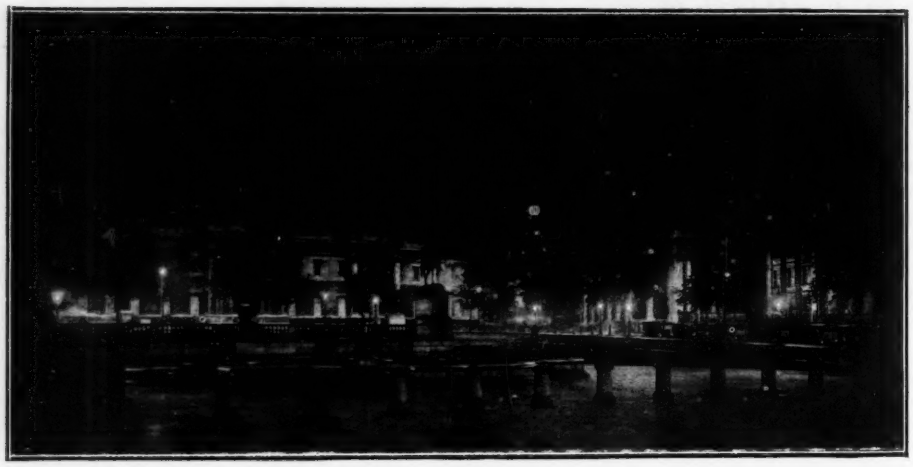


FIG. 1.—Low-pressure Inverted Incandescent Gas Lamps are used to illuminate Trafalgar Square. The octagonal lamps on the four corners of the coping are made of cast bronze, and are fitted on dwarf bronze columns mounted on stone piers. They are 34 inches wide, and the mantles are about 17 feet above the level of the road. Ten other circular lamps, 24 inches wide, are mounted on cast iron columns fixed on the stone coping surrounding the Square. The average height above the road of the mantles in these lamps is 12 feet. Every lamp is fitted with a 5-light cluster of No. 2 mantles on a single super-heater. The lamps are lighted and extinguished by means of by-passes controlled by cocks in the bases of the lamps.

The Lighting of our Streets

WHATEVER the pessimist may have to say of civilization in the present century, this is at any rate an age of progress in the sense that no industry can survive it without constantly improving on its methods. Had the intervention of incandescent gas lighting by von Welsbach in the 'eighties been the last step forward in the history of gas illumination, it is certain that the incandescent mantle would to-day be rather an exhibit in museums than a familiar fitting in private and public buildings and in streets. But the improvements in gas lighting still go on, and, despite the development made in the application of gas, both to heating and to power, a great part of the gas manufactured in the British Isles is still consumed as an illuminant.

One of the first of these improvements was the introduction in 1900 of the inverted incandescent burner, which is not only subject to more artistic treatment, but is much more durable than the upright burner of von Welsbach.

For powerful lighting on a large scale the introduction of the high-pressure system, applicable wherever a gas main is conveniently near, marked another great advance. The principle of this method is that the high-pressure gas entrains more air with it, and so gives a hotter flame. Lamps of high candle-power—as high as 5,000 candles—are usually so lit where possible.

For lighting with gas at ordinary main's pressure the new super-heated incandescent gas burners, which give as much as 50 per cent. more light per cubic foot of gas consumed than was previously possible, have been extensively adopted. The gas and air mixture passes to the burners in a pre-heated condition, the effect of which is a higher flame temperature and a consequent increase in mantle luminosity. Small mantles, which not only have a longer life than large ones, but are more easily brought to a state of full and uniform incandescence, produce a remarkably high degree of brilliancy, when lit by this method and arranged in " cluster " form, a plan which loses nothing in convenience, since the cluster lamp, whether composed of two or twenty burners, can be adjusted by the turn of a single regulating screw.

Another invention that has increased the convenience of gas for lighting is the long-distance control, whereby a number of lights, as in a railway station, shop or street, may be turned on or off by a single operation.

The incandescent gas light of to-day is closely akin in colour to daylight, and its fog-penetrating capacity is of especial value during the autumn and winter months. One has only to walk (or, better still, to drive a car) on a foggy day through some of London's best-known thoroughfares—Victoria Street, Parliament Square, Whitehall, Trafalgar Square, Regent Street and Pall Mall, to mention just a few—to appreciate the important part played by the magnificent gas street lighting installations in combating the denseness of the fog, and thereby reducing the risk of accidents in routes which are always crowded with vehicles and pedestrians.

The Gas Light and Coke Company alone lights no less than 1,000 miles of London's streets, and the courtyard of Buckingham Palace is illuminated by a gas installation in keeping with the national importance and dignity which attach to the official residence of the King.

FIG. 2.—The Precincts of the Houses of Parliament are lighted by globe-shaped Incandescent Gas Lamps. The lanterns, which have been in position for many years past, contain the latest form of lighting clusters with super-heater, the latter being a heated chamber through which the gas and air passes and becomes heated prior to combustion. The pre-heating of the gas and air mixture results in a higher flame temperature, and this higher flame temperature in turn leads to greater mantle luminosity.

FIG. 3.—Whitehall, London's most important thoroughfare, with its magnificent Government buildings, is one of the best lighted streets in the world. High-pressure Incandescent Gas Lamps are used for its illumination, and add to the dignity of a street famous for its fine examples of British architecture. Each lamp is fitted with two High-pressure Inverted Incandescent Gas Burners and gives a light of over 2,000 candle-power. The mantles in these lamps are 20 feet above the road level.

FIG. 4.—A night photograph of Regent Street—London's best-known shopping thoroughfare. This important street is lighted by means of twenty 3,000 candle-power High-pressure Inverted Incandescent Gas Lamps on columns placed in the centre of the roadway. The mantles are 20 feet above the level of the roadway. The brilliancy of the illumination provided is obvious, as also is the complete absence of deep shadow.

FIG. 5.—Vauxhall Bridge is lighted by 18 inch circular Low-pressure Gas Lamps. The lighting units are 5-light clusters of No. 2 size inverted burners with single super-heater. The height of the mantles above the road level is 12 ft. 6 ins. The roadway is 30 ft. 6 ins. wide, and the lamps are fixed near the edge of the pavement at an average distance apart (measured along the kerb) of 150 feet. The lamps are lighted up and extinguished by means of flashing by-passes controlled by cocks placed at the tops of the columns.

Some Notes on Lighting at the Ideal Home Exhibition

(By An Engineering Correspondent)

THE Ideal Home Exhibition, held at Olympia during March 2nd to 25th, was an interesting display. On the whole one must admit that the lighting was much better than at many exhibitions in the past. The general lighting was by means of overhead gasfilled units, placed well out of the range of view; the great majority of the stalls made use of well-screened lamps, a feature being the use of coloured shades and bowls.

In the section devoted to housing exhibits, the overhead lamps, below a white canopy, gave quite a good effect, and the local lighting improvised over several of the exhibits gave a fair impression of bright sunlight. Special attention has been devoted to the exhibition of gardens in the annexe. Rock-gardens, fountains, rose-gardens, etc., made a delightful display. One noticed the effective concealed lighting of Carter's exhibit, with its playing fountain, and the colours in the illuminated "sky" behind the Japanese tea garden were quite effective. The general lighting of this considerable area, which was designed by Mr. G. W. Robinson, floods the entire area with mellow light. For this purpose special large reflectors five feet square at the mouth, two feet square at the top and two feet deep, were designed. There are thirty-six of these reflectors and each carries three gasfilled lamps in opal bulbs. The reflectors are mounted high up, very close to the overhead canopy. The illumination is well diffused and, as the lighting units are well out of the ordinary range of view, the effect is not unlike diffused sunlight. The effect appears to have been quite economically obtained. The only criticism one might make is that observation of the fittings keeps in the mind the impression that the lighting *is* in fact artificial! The ideal arrangement—no doubt impracticable in an exhibition of short duration where the lighting is necessarily improvised—would perhaps be "an artificial firmament" similar to that used in the Fortuny system of stage lighting. Mr. Robinson, by the way, is also responsible for an ingenious device occupying the centre of the main hall, a large ornate fountain, which is something of a mystery, as there is no feed pipe or apparatus to carry away the excess water. The fountain is essentially self-contained, and its use in conservatories, etc., would make a pleasing addition to an "all-electric" home.

Reference to all-electric homes leads us to mention next the electrical exhibit, a joint effort of the E.D.A. and the E.L.M.A., adjacent to the entrance to the gardens. This has likewise a small fountain outside, and the words "Electric Home" are outlined by the new principle (recently described before the Illuminating Engineering Society) showing the letters outlined with a bright red rim, which the uninitiated might quite easily mistake for neon tubing. The exhibit was popular, and the writer had to wait for some time in the queue before we were passed through the portal (equipped with a device bearing the name of the house and also illuminating the front steps). The young men in charge of the demonstration performed their duties efficiently. Visitors were shown the difference between the effect produced by three bare lamps in an antiquated cluster of shades, and modern devices, which included semi-indirect bowls (some of the pedestal and bracket types), portable lamps, standards of the duplex type enabling light to be either directed downwards for reading or diverted upwards to the ceiling, and other novelties. In the bedroom the control of the lamp at the bedside, or the alternative arrangement of a cylindrical fitting clamped to the top bar of the bedstead were shown. Another device was the cupboard which, on being opened, automatically switched on a lamp illuminating its interior.

One was glad to see that kitchen requirements were emphasized. The contrast between the lighting obtained from the old-fashioned single pendant with opal shade and the diffusing-glass enclosed units mounted on the ceiling was quite striking.

Subsequently other domestic applications of electricity for heating, cooking and drying, etc., were on view. (Surely the electrically heated bootjack is the last word!)

Adjacent to this stand is the London Joint Gas Exhibit. This is designed on dignified lines, and was also well attended. Naturally all the latest applications of gas for heating and cooking were shown. The bathroom arrangements struck one as particularly well conceived, and the small bijou burners equipped with vitreosil shades make a most pleasing unit for corridors, etc., which should be in every gas-lighted home. The tables were equipped with portable lamps fed through flexible tubing, and the general note in the lighting was subdued cosiness. General lighting was provided by clusters of inverted mantles in lanterns of decorative ironwork.

Gas and electric lighting being thus demonstrated, it was quite appropriate that one of the nearest stands should be devoted to the Aladdin incandescent oil lamps. The stand was equipped to resemble Aladdin's cave, and there was a good display of both of the paraffin lamps (table, pendant, pedestal, bracket, and other forms), and the Aladdinette "everlasting" candles and nightlights. These lamps, it may be recalled, make use of an incandescent mantle, but burn paraffin vapour. They are entirely self-controlled and of extreme simplicity. An effective demonstration was the tilting over of a lamp before the audience. The only result was that the lamp was extinguished; it is therefore claimed that these lamps are absolutely safe.

Space prevents our referring in detail to many other exhibits dealing with lighting. Mention should, however, be made of the display of special decorative units by L. G. Hawkins & Co., which illustrate the great advances that have been made in decorative glassware from the crude shades of only a few years ago. Messrs. Girdlestone & Co. had also a pleasing display of alabaster and hand-painted fittings. We were interested to see that the Sheringham Daylight Development Co. is exhibiting. The recently designed units marks a distinct advance over those originally produced, and the prices of these special units have now been brought down to quite reasonable figures. There were also numerous lighting sets for country houses, amongst which may be mentioned Spenser's "Silverlite." Besides the uses of petrol air-gas for lighting and heating this firm also illustrated the application of the system to poultry-farming. The Delco Light (electric) and Aerogen (petrol air-gas) plants were also on view. There is no doubt a good field for such apparatus for country houses.

The Lighting of the Capitol Theatre

THE lighting of the Capitol Theatre—described as London's latest super-cinema—possesses several novel features, and the following account, based on information received from the General Electric Co., Ltd., should be of interest to readers.

As regards exterior lighting, the chief feature is a large glass tower illuminated at night time by vacuum and gasfilled lamps, and visible from a considerable distance. Immediately below the tower are four bronze lanterns, whilst flambeaux-type fittings are also used at intervals round the building. The name "CAPITOL" is displayed by a sign of the box type, but of novel construction. The interior of each box is painted red, and is almost covered with a ruby-coloured non-transparent material, leaving a uniform small space round the edges of the letters. Each box contains lamps, so that at night-time the name is apparently outlined in tubes of ruby-coloured light. In addition the frontage is effectively flood-lighted by means of twelve projectors, each equipped with a 500-watt gasfilled lamp.

Fig. 1 illustrates the main entrance hall, which is lighted by pear-shaped amber-tinted lamps, mounted on a specially constructed framework to ensure even illumination of the ornamental ceiling fixture. In the interior of the theatre special colour effects are introduced. The colour scheme is in silver and grey, the upholstering in purple, and the decorative scheme throughout the whole of the theatre is based on the use of four colours—purple, blue, red and white. The stalls are illuminated by one large central fixture 9 ft. in diameter, and four smaller ones round it. Other lamps, in various colours, are concealed round the cornice, and by means of switches and dimmers the general colour scheme can be altered at will.

Fig. 2 illustrates a special feature, the ornamental "fountains," one on either side of the auditorium. The basins of white are equipped with frosted and tinted lamps, giving four-colour indirect lighting effects. The auditorium lighting is also supplemented by the illumination of an ornamental cove immediately over the proscenium. The dome (Fig. 3) is illuminated by a number of lamps concealed in the base.

Below the theatre is a large dance hall, where the lighting is also highly decorative. Finally, one small but interesting feature of the arrangements deserves mention: the illumination of the floor and steps leading to the various seats. This is effected, in the body of the theatre, by means of "Osglim" (neon) lamps mounted behind diffusing glass screens recessed in the wall. In the circle the lamps are recessed into the steps (one in each step). Each glass has a letter painted upon the under side, so that persons moving up or down the steps can easily locate the row containing their seats.

We are informed that the lighting scheme described was designed by the Illuminating Engineering Department of the General Electric Company, Ltd., in collaboration with Mr. Andrew Mather, the architect, and the entire installation carried out by Messrs. Grierson, Ltd.

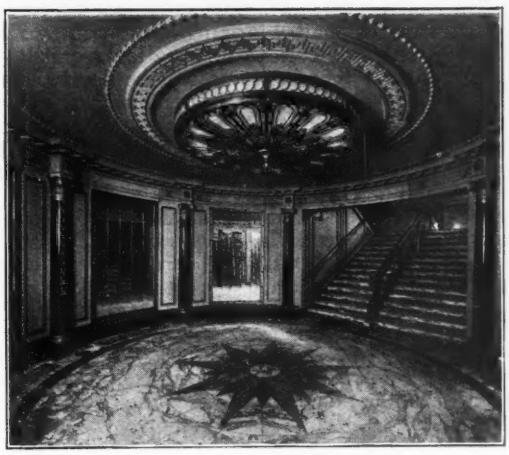


FIG. 1.—The Main Entrance Hall.

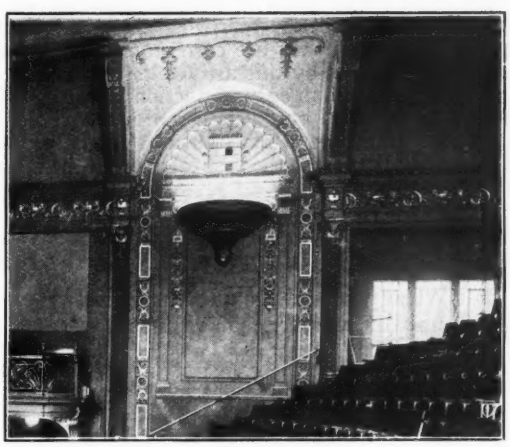


FIG. 2.—One of the Illuminated Fountains.

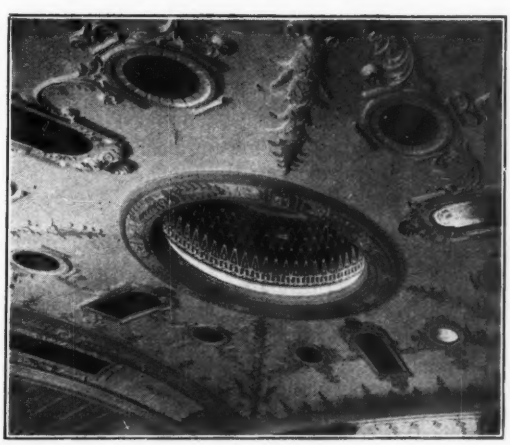


FIG. 3.—The Illuminated Dome.

Artificial Light on the Poultry Farm

In a recent conversation with Mr. G. C. Pillinger, who is introducing into this country various forms of electrical apparatus which are stated to have proved very successful for poultry farming in the United States, we were given some curious information regarding the value of artificial light in promoting the development of chickens. From the very start development is aided by the use of electric lamps, first in the incubator and next in the brooder, and in both cases the artificial warmth, capable of exact regulation, is said to be an improvement on the natural process.

Artificial light, besides heat, plays a great part in this process of development. In the short hours of daylight available in this country at some periods of the year the birds sleep too much and eat and exercise too little. By extending the hours of activity by using artificial light the progress of the birds can be hastened considerably, and the laying period is more quickly reached. It is, however, necessary to reach a certain standard of artificial illumination. Otherwise the chickens only observe and eat certain ingredients of the food, such as the light-coloured maize which is most easily seen, and neglect other elements, such as those containing proteins or lime. Abundant illumination ensures that all the food-elements are seen and eaten. Curiously enough the amount of light found necessary—about 1 c.p. per square foot—is broadly similar to that used in most installations for human needs.

The use of artificial light also assists intensive egg-production. It is worth noting that eggs produced under these conditions are not suitable for hatching purposes. But the number of eggs for eating purposes can be increased at periods of the year when there is apt to be a shortage, and when they are correspondingly valuable. It is hardly possible, by this artificial stimulus, to make a permanent increase in egg-production, i.e., to get from each hen an increased output of eggs for the whole year. But the essential thing is that the eggs can be produced at a time when they fetch the best prices, and the stimulus afterwards withdrawn.

Just News

When you read the morning paper
And the weather man says rain,
That's news.

And you see the Pittston miners
Have gone on strike again,
That's news.

Major Hylan starts proceedings
And a Transit Board attack,
That's news.

Or perhaps he's been to Palm Beach
And in six weeks he'll be back,
That's news.

The State Police gird city
To enforce the Auto Laws,
That's news.

And the bootleg ring in Jersey
Is in politicians' claws,
That's news.

But when before some engineer
I. E. S. transactions do appear,
Convention papers all are there
But not a word from anywhere,
That's *not* news!

—*The Transactions of the Illuminating Engineering Society, U.S.A.*

The above is from the front page of the January issue of the Transactions of the Illuminating Engineering Society (U. S. A.). In our journal we include the Transactions of our own Society, and we aim at presenting notes and news on illumination from all quarters as well. Will our correspondents kindly note?—We want *News!*

Lays on Illumination

III.—TIMOTHY BANNISTER BRIGGS.

Timothy Bannister Briggs
Kept a general store.
He used to say
That what was good enough for his father
was good enough for *him!*
That he was a self-made man
(Thereby relieving his Creator
Of a serious responsibility).

He would not move with the times.
He said:
"A Penny Saved is a Penny Gained,"
And
"Look after the Pence, and the Pounds
will look after themselves."
And
He applied these precepts to lighting.
Now this is "vers libre."
But we shall never get on,
Unless we return to a more convenient metre.
Therefore—

Timothy Bannister Briggs
Found business receding to zero;
To cope with the crisis
He marked down his prices
And dressed his attendants like Pierrots.

But he utterly failed to observe
That darkness is fatal to "Biz";
No shop in the row
Had such bargains to show,
But none so ill-lighted as his!

His goods were attractive and cheap,
His windows were changed every night,
But the public passed by,
Something else caught their eye
(His rivals had plenty of light).

Luckily Briggs had a son
Who's attended an I.E.S. meeting;
And he told his old Dad:
"If our lighting's so bad,
It isn't worth while our competing."

"Everything's gloomy as death
And people won't buy in the dark;
We've just been caught napping,
Our lamps all want scrapping,
Our reflectors came out of the Ark!"

Timothy Bannister Briggs
Was a sceptic—refused once or twice;
Indisposed by the worry
He retired into Surrey
Whilst his son sought for expert advice.

The place was repainted throughout
And illumined as never before;
The frontage flood-lighted
And the windows requited
With twenty foot-candles or more.

T. B. B., from his invalid couch,
Wrote letters deploring expense,
Till his health was restored
By good news from the Board
Of "Business that's simply immense."

But I hear Scotland Yard is concerned
How to deal with the traffic at night,
And is much disconcerted
By the crowds now diverted
By B's applications of light.

MORAL.

In former days the 'prentice cry
Of "What d'ye Lack?" beguiled the *Ear;*
Now merchants know that to the *Eye*
Their wares attractive must appear.

LIGHT, the great salesman of to-day,
In silence issues his appeal,
And GOOD ILLUMINATION may
Have potent power to "close a deal."

dolce far niente

THE gas in a gasfilled electric lamp is an elegant idler; it *does* nothing, yet is highly effective. In the passive role of heat conductor, it permits the rapid transmission of heat from the filament to the bulb, and thus enables the filament to be run at a very much higher temperature, and therefore at a correspondingly higher efficiency, than would otherwise be possible.

By applying the cooling solace of complete inertia to the fevered efficiency of the filament, this wonderful gas saves the money and increases the light of all who use gasfilled lamps

And the master patent governing the manufacture of *all* gasfilled lamps is a Mazda patent.

MAZDA
THE ORIGINAL *Gasfilled*
ELECTRIC LAMPS

B T-H

Advertisement of The British Thomson-Houston Co. Ltd
Makers of Mazda Lamps and B.T.H. Radio Valves

2299

THE PHILIPS' ELECTRIC LAMP WORKS.

The electric lamp factory of Messrs. Philips' Glowlamp Works, a general view of which is shown in Fig. 1, has many interesting features. The factory is situated at Eindhoven, Holland. It is, we understand, the largest self-contained lamp factory in the world. It undertakes every process connected with the production of electric incandescent lamps, for which it draws its own special material from sources in many parts of the world. And during the last thirty-four years it has grown to a stage when it produces annually about one-seventh of the total output of lamps in the world. It is stated that a quarter of a million lamps leave the factory each day and are shipped to different parts of the world.

FIG. 1.—A general view of Philips' Electric Lamp Works at Eindhoven (Holland).

In one building, shown in Fig. 1, upwards of 7,500 men and women are employed. With so large an output much of the work is naturally automatic. But researches are constantly going on, and more than 100 engineers, physicists and chemists are employed on the permanent staff. The growth of the employees has led to the formation of a veritable town in the vicinity of Eindhoven. In "Philips Town" (Fig. 2) something like 1,500 model dwellings, built by the firm, are leased to employees at very moderate rents. The illustration gives a good idea of their pleasing appearance. Free medical treatment is given, and the firm makes a special feature of welfare work. There are ample playing fields and stores, run by a co-operative organization of the workers. Further, a system of copartnership is in being with a view to interesting foremen and employees in the development of the works. Part of the annual bonus is given in the form of shares. A pension fund is provided for the benefit of widows and orphans, and for employees after reaching the age of sixty.

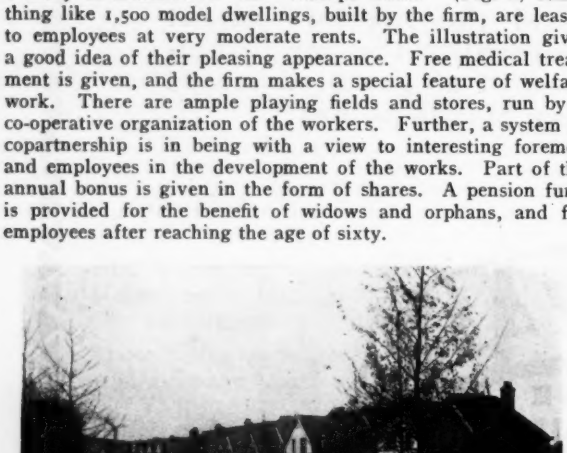


FIG. 2.—A street in "Philips Town," showing some of the model houses erected by the firm for its workpeople.

These facts are mentioned to show the spirit in which this large organization is run. Let us now turn to more technical details. We have mentioned that the works has its own special avenues of supply for such materials as tungsten, ingredients of special glasses, etc. It is famous for its facilities for glass manufacture. The glassworks, established in 1916 (see Fig. 3), have since been extended, and now comprise twelve furnaces and employ about 1,500 men. Besides completely meeting their own requirements, the firm supplies glass tubes and articles used for the making of lamp-bulbs in large quantities. We understand that a very high standard of quality and uniformity is maintained in this department. Although, with such a vast output, much of the factory is necessarily devoted to the making of standard forms of lamps, Messrs. Philips' Electric Lamp Works are always ready to tackle special problems. The white "Argenta" bulbs, now made in all sizes up to 500 watts,

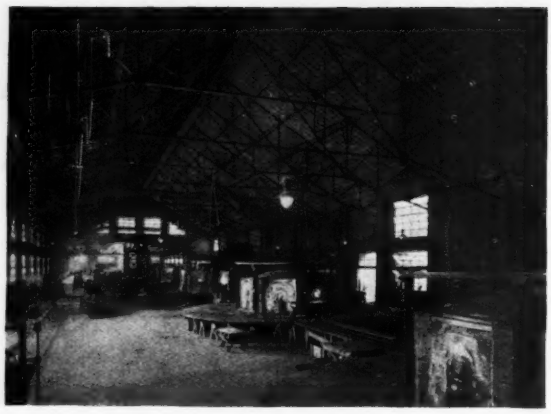


FIG. 3.—The Interior of the Glass Factory.

illustrate such special developments; much additional work is done in connection with radi-valves, X-ray tubes, high-pressure rectifiers, etc.—all involving delicate glasswork.

The furnaces are of the very latest type and, it is interesting to note, are heated by gas generated on the premises. We have here one more instance of the interlinking of the gas and electric industries—gas even serving to aid in the production of the rival illuminant!

Needless to say all the processes involved in the manufacture of tungsten filaments are carried out *ab initio*. At the time the tungsten filament was first introduced the firm organized a chemical department for the production of very pure tungsten, such as can be drawn down to 0·0004 in. for small high voltage lamps, whilst diameters of 0·04 in. and more are used in the stout spirals of special focus-lamps used in kinema projectors. In passing we may note one other instance of specialized lamp manufacture—the very powerful lamps which have been constructed for lighthouse work. Standard 4,000 watt lamps are now available and experiments are now being made with 10,000 watt lamps. Such lamps would presumably yield something like 20,000 candle-power, a truly remarkable intensity to be reached in an incandescent lamp!

Other gases naturally enter into the processes of manufacture. Many thousands of blow-pipes fed by gas and compressed air and oxygen are used. Hydrogen, likewise generated at the works, plays a part in the reduction of the tungsten ore. A plant is in operation producing 1,200 litres of liquid air per hour. On distillation the oxygen is first separated from the nitrogen, and from the latter the valuable, rare gas argon, largely used for gasfilled lamps, is obtained. A feature of the operations is the very high degree of vacua attained by the use of specially designed pumps, some of which are unique. Our final illustration (Fig. 4) shows the high voltage sparking apparatus used in testing work.

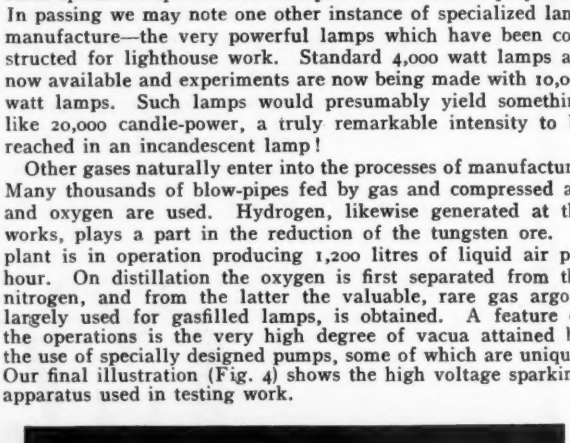


FIG. 4.—Showing High Voltage Spark Apparatus.

We may conclude this note by quoting two instances of the entirely self-contained methods on which this factory is run. The first of these is the manufacture, in a special engineering department, of all necessary automatic machinery needed for the production of lamps. The next is the existence of a special subsidiary factory devoted to the manufacture of cardboard boxes and packing materials. Like the glass factory this has long outrun the immediate requirements for the firm's own lamp production, and now supplies cardboard boxes to many concerns not even remotely connected with the electric lighting industry.

TRADE NOTES & ANNOUNCEMENTS

BENCOLITE UNITS.

The accompanying illustration, taken from a leaflet recently issued by Benjamin Electric, Ltd., shows one of the Bencolite fittings, to which we referred last month. This is a totally enclosed unit embodying a one-piece glass reflector of special design and of dustproof construction. In the list before us a second design, of somewhat different shape but with similar characteristics, is also illustrated, whilst a third illustration shows typical reflectors designed respectively for 40-60 and 100 watt lamps.

The chief feature of all these forms is the good diffusion of light, coupled with pleasing appearance. It is stated, however, that the diffusion is attained without undue loss of light from absorption. We understand that these units are proving very popular for lighting large and imposing offices, showrooms, etc.

A FORTHCOMING "ALL-ELECTRIC" EXHIBITION.

Our attention has been drawn to the forthcoming "All-Electric" Exhibition, to be held in Leicester during October 8th-17th next. The object of the Exhibition is to bring buyers and users into touch with manufacturing progress, and advanced principles of design and practice. Only exhibits directly pertaining to the most modern work in industrial, scientific and domestic applications of electricity will be permitted.

The Exhibition will be held in the Junior Training Halls, Leicester, which are stated to be probably the finest in the provinces; of the two large halls one will be devoted to industrial exhibits, the other to the scientific and domestic field, including wireless.

Full particulars may be obtained from Mr. T. Percy Bentley, 32, Victoria Street, Manchester.

FLOOD-LIGHTING OF THE BELFAST CITY HALL.

We have received from the British Thomson, Houston Co., Ltd., some fuller particulars of the above installation, which was illustrated in our February issue (p. 56). The total width of the building is approximately 300 feet. The main wall is 70 feet high and the height to the top of the dome is 170 feet. The surface is lighted with eighteen B.T.H. flood-light projectors, equipped with 500 watt Mazda gasfilled projector type lamps. Sixteen of the projectors are fixed, two on each of eight tramway standards, in front of the building. These standards are about 100 feet away from the front of the City Hall. The remaining two projectors are fixed one on each corner of the top of the main building, so as to flood-light the sides of the dome.

It will be observed that in this case it was possible to mount the projectors a considerable distance away from the surface illuminated, a circumstance which is usually favourable to even illumination and avoidance of unsightly shadows.

THE EMPIRE GAS EXHIBIT.

We understand that gas will again be well represented at the British Empire Exhibition this year. A feature of the display will be characteristic tableaux illustrating the thousand and one uses of gas throughout the Empire. The exhibit will be held, as it was last year, in the surroundings specially designed for it by Mr. H. Austin Hall, F.R.I.B.A., in the centre of the Palace of Industry.

E.D.A. ELECTRIC CALENDARS.

The British Electrical Development Association send us a copy of the second edition of the "Electric Calendar," printed in three colours with effective headings for each month. A four-page leaflet is devoted to each month, the front page bearing the calendar and the inside pages appropriate readable notes, pointing out the applications of electricity in each season of the year. Full particulars as regarding prices, etc., may be obtained on application to the British Electrical Development Association Inc., 15, Savoy Street, London, W.C.2.

Bencolite Totally-enclosed Unit.

GAS AT THE BRITISH INDUSTRIES FAIR (BIRMINGHAM).

At the British Industries Fair being held in Birmingham this month there is also an effective gas exhibit. One of the steel houses at the Fair has been fitted throughout for lighting, heating and cooking, and the provision of hot water by the Birmingham Gas Department. The exhibit is thoroughly practical and fancy or expensive appliances have been avoided. Attention is drawn to service effected by the elimination of smoke-producing fires, resulting in a saving in chimney construction and also constituting an advance towards realization of smoke-free air and clean surroundings.

CONTRACTS CLOSED.

The following contracts are announced :—

MESSRS. SIEMENS and ENGLISH ELECTRIC LAMP CO., LTD. :

Southern Railway Co., the supply of incandescent electric lamps during six months ending August 31st next.

The Admiralty, 5,000 (approximately) special electric lamps.

THE GENERAL ELECTRIC CO., LTD. :

The Admiralty, a large contract for the supply of 50,980 special Robertson carbon filament lamps.

The G.P.O., an order for 10,000 special telephone switchboard lamps.

FIG. 1.—The Ceag 4-Volt Lamp.

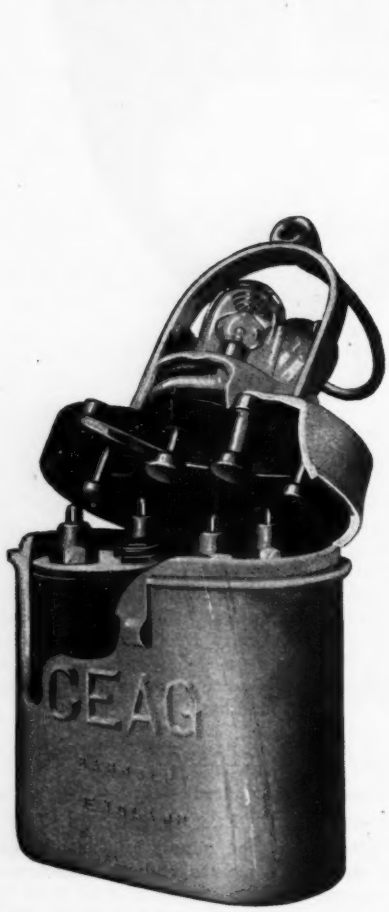


FIG. 2.—The same lamp open, showing use of two 2-volt standard cells.

THE NEW "CEAG" 4-VOLT LAMP.

In this journal the need for more and better light in mines has been continually pointed out. The collier, cut off from all other sources of light, depends solely on his portable hand lamp, and within recent years the candle-power available has been substantially increased; we understand that, according to the latest Departmental Reports, over 70,000 additional electric lamps have been introduced in mines during the last year.

Now the advantage to be derived from the use of electric lamps depends essentially on the possibility of increasing the candle-power to a value such that the conditions liable to cause "nystagmus"—a disease associated with work by insufficient light—are eliminated. It is satisfactory to note that steady progress in this direction is being made. The candle-power of the average miner's electric lamp is probably between 1 and 1·5. The introduction of the "Pillarless" lamp and the addition of a reflector increased the working candle-power to about 2·5. But it was recognized by authorities that a still further increase in candle-power was desirable.

To meet this demand for more light, the Ceag Company, after long and severe trial underground, has evolved their 4-volt lamp. This has many interesting features. Firstly use is made of two standard type circular Ceag accumulators to make the battery, the circular concentric electrodes are retained as the type furnishing the greatest strength. (Incidentally this is advantageous in relieving the colliery company of carrying more than one kind of spares and enabling the same charging gear to be used as for the ordinary electric lamps.)

The two accumulators are carried in an aluminium case and are located in position by means of two indents in the bottom which retain them in the correct position. To prevent the cells being placed in the wrong position for polarity the case is so arranged that in this event the lid will not close. The connections between the accumulator and the interior fittings are of the unit insulator type, and can be dismantled along with the wellglass, bulb, etc., in about fifteen seconds—an important point where there are large installations of these lamps.

The lamp is fitted with a patent safety device which, in the event of the wellglass breaking, automatically disconnects all the exposed parts from the accumulator. The safety fuse is fitted to the 4-volt lamp, where it is more essential. (The Mines Department insist that such a safety device must be fitted to all 4-volt lamps for use underground.)

The interior fittings, wellglass, etc., are of the Ceag standard pattern, and include the patent ratchet type retaining ring. The lid is also an aluminium casting and carries a bridle for the external reflector, for the lamp is of the pillarless type. The reflector is a one-piece stamping and is highly polished and nickel plated, giving an excellent reflecting surface. The candle-power of the bulb is 4 c.p. in all directions, but it is stated that when the reflector is used the effective candle-power is increased to 12.

The weight of the lamp is 10 lbs. 4 oz. complete with accumulators. With this comparatively small increase approximately four times the illumination is obtained. It was at first thought that the increased weight might be an objection, but we understand that the lamp is in great demand among progressive collieries, and that, in view of the increase in light, the men willingly accept the additional weight involved.

THE NEW WELSBACH SPRING LIST.

The new Welsbach Spring List, just received, as usual illustrates the wide interests of the Company. Gas heating is represented by several novelties, which include a modified form of gas iron, the "Suburbia" gas cooker, and a new gas heated copper. On the electric side we have the new Welsbach-Kern electric fire, a feature being the complete control, effected by foot-press switches, enabling three separate heats to be provided. For country dwellings the Welsbach oil heating and cooking stove is recommended. This is small and compact, and has many varied uses.

Another feature in this list is the increased range of pressed and cut glass table ware, which are listed at very reasonable prices.

A THOUSAND AND ONE USES OF GAS.

A well-got-up issue of the above publication (Vol. xiii, No. 132), issued by the British Commercial Gas Association, illustrates the application of gas lighting in hospitals. There is a brief introductory note on Westminster Hospital (the oldest of the London hospitals supported by voluntary subscription), and an account of recent enlargements. The various pictures are well chosen. We like particularly the views of several private paying wards and the sisters' sitting room. Besides its primary use for maintaining even temperatures in the rooms, gas finds many applications for laboratory equipment—for instance, for incubating the bacilli of various diseases. The cooking is also done by gas, so that the hospital can be regarded as doing its share towards smoke-abatement.

REVIEWS OF BOOKS AND PUBLICATIONS RECEIVED

HEALTH, WELFARE AND SAFETY, *January, 1925. (J. Guthrie Oliver & Co., Southport.)*

The growing interest in matters affecting the health and safety of industrial workers is illustrated by the issue of a new journal of " Health, Welfare and Safety " of which we have received the first copy. There is undoubtedly a need for journals dealing with this subject. The number before us contains articles on such matters as Temperature and Ventilation of Factories, Fire and Fire Prevention, " Safety First " in Industry, and various occupational diseases. We are also glad to see that the question on lighting is not overlooked. There is a contribution on " The Advantages of Good Lighting," so that all the main aspects of the subject are being considered. We wish this new venture every success.

THE ORGANIZATION AND ADMINISTRATION OF GAS UNDERTAKINGS, *by Edwin Upton, F.S.A.A. (Sir Isaac Pitman & Sons, Ltd., London, 1925, 122pp., 5s. net.)*

In this book Mr. Upton, who is treasurer of the Liverpool Gas Company, reviews problems of administration of gas undertakings. Broadly, the first six chapters deal with legislation. The author traces the birth and development of the industry, discriminates between statutory and non-statutory undertakings, and presents the clauses of the most important Acts controlling gas administration. Next we come to administrative details. After discussing such matters as the sliding scale, reserves, allocation of profits, etc., the nature and objects of a costing system in manufacture, and the checking of gas made, used, sold, and unaccounted for, are considered. Chapter VIII contains, as insets, forms showing daily carbonizing results, details of residuals, etc. Chapter IX, dealing with the control of gas companies, explains the duties of the supply department, methods of gaining the goodwill of consumers, requirements in personnel, methods of filing correspondence, etc. Subsequently methods of rental, the slot meter, and other details affecting relations with the consumer are considered. The final chapters deal mainly with allowances for depreciation and other financial matters. While primarily intended for those in the gas industry the book should be of interest to those outside. It gives a good insight into the highly complex conditions underlying the work of gas undertakings and regulating their services to the public.

THE ORGANIZATION AND ADMINISTRATION OF THE ELECTRICITY UNDERTAKING, *by C. L. E. Stewart. (Sir Isaac Pitman & Sons, Ltd., London, 1925, 169pp., 6s. net.)*

This, like the volume dealing with gas undertakings referred to above, forms one of Pitman's Municipal Series, and follows similar lines. The initial chapters deal with Government and municipal control, and the power station, mains and substations, test-room, publicity department, etc., are reviewed in turn. There is a good account of the work of the head office, and a chapter is devoted to a comprehensive analysis of all-in costs. This, too, should prove a useful publication.

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